CANALS AND OTHER INLAND WATERS

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By WILLIAM A. COUNTRYMAN.

The statistics in this section relate to transportation by all vessels, documented and undocumented, of 5 tons net register or over, on all canals except ship canals, save that the Chicago Drainage and Ship canal is included; on all lakes except the Great Lakes; on all rivers, canalized or other, tributary to the Great Lakes, but not on any river tributary to the Mississippi; on the Red River (of the North); and above tidewater on all rivers tributary to the Atlantic and Pacific oceans and the Gulf of Mexico.

TABLE 1.—ALL VESSELS AND CRAFT: 1906.

[In addition to the craft reported in this table there were 68 vessels, with a gross tonnage of 7,368 reported as idle in 1906.]

	AGGREGATE.			STEAM.[1]			SAIL.			UNRIGGED.		
	Total.	Canals and other inland waters of New York state.	All other inland waters.	Total.	Canals and other inland waters of New York state.	All other inland waters.	Total.	Canals and other inland waters of New York state.	All other inland waters.	Total.	Canals and other inland waters of New York state.	All other inland waters.
Number of vessels	2,140	1,648	492	337	151	186	14	13	[2] 1	1,789	1,484	305
Gross tonnage	259,491	209,152	50,339	21,507	14,127	7,380	518	495	23	237,466	194,530	42,936
Value of vessels	$4,586,791	$3,294,221	$1,292,570	$2,225,673	$1,390,512	$835,161	$16,800	$16,000	$800	$2,344,318	$1,887,709	$456,609
Gross income	$3,957,729	$2,781,604	$1,176,125	$1,005,469	$525,970	$539,499	$4,250	$4,250	.....	$2,888,010	$2,251,384	$636,626
Number of employees	3,731	2,472	1,259	1,153	590	563	11	11	.....	2,567	1,871	696
Wages	$1,361,030	$920,260	$440,770	$412,134	$192,238	$219,896	$1,620	$1,620	.....	$947,276	$726,402	$220,874
Number of passengers carried	1,877,889	835,052	1,042,837	1,871,769	828,932	1,042,837	.....	.....	.....	6,120	6,120	.....
Freight carried, including harbor work (net tons)[3]	3,944,655	2,712,481	1,232,174	261,315	105,498	155,817	6,968	6,968	.....	3,676,372	2,600,015	1,076,357

[1] Includes all craft propelled by machinery.
[2] A pleasure yacht.
[3] Harbor work amounted to 227,890 tons, of which 1,500 tons were reported for steam vessels and 208,090 for unrigged on canals and other inland waters of New York state, and 18,300 tons for unrigged vessels on all other inland waters.

In only a few particulars can the statistics for 1906 and 1889 be compared. At the earlier census separate reports were made for transportation on canals and canalized rivers and for transportation on Lake Champlain; statistics for the Red River (of the North) were shown separately among the statistics for rivers of the Mississippi valley; statistics for freight traffic, except on Lake Champlain and the Red River (of the North), were reported by the management of the canals, and not by the boat owners as in 1906. The income and expenses also were those of the canal companies and not those of the boat owners; and no returns of employees or wages for canals and canalized rivers were given. The only comparison possible is with the number, tonnage, and valuation of canal boats, and the average value and tonnage.

TABLE 2.—NUMBER, GROSS TONNAGE, AND VALUE OF VESSELS, BY CLASS: 1906 AND 1889.

	TOTAL.			STEAM.			SAIL.			UNRIGGED.		
	1906	1889	Per cent of increase.	1906	1889	Per cent of increase.	1906	1889	Per cent of increase.	1906	1889	Per cent of increase.
Number of vessels	2,140	6,575	[1]67.5	337	163	106.7	14	25	[1]44.0	1,789	6,387	[1]72.0
Gross tonnage	259,491	996,629	[1]74.0	21,507	19,223	11.9	518	1,925	[1]73.1	237,466	975,481	[1]75.7
Value of vessels	$4,586,791	$6,138,914	[1]25.3	$2,225,673	$790,000	181.7	$16,800	$36,800	[1]54.3	$2,344,318	$5,312,114	[1]55.9

[1] Decrease.

In the statistics of transportation on Lake Champlain for 1889 there are more details that could be compared with those of 1906, if a separate showing of the traffic on this lake were practicable for the later census. The details for the Red River (of the North) do not include the operations of 11 unrigged vessels; for these, only tonnage and value are given.

The increase in boats operated by steam and the

decrease in all other kinds represent the tendency in transportation on inland waterways. The unrigged boats decreased in number very materially, although they still outnumbered the steam vessels. In value the two classes were, as a whole, about the same in 1906; in tonnage, however, there was a wide difference in favor of the unrigged craft, which leads to the conclusion that the increase in steam craft on inland waters is due to their use for towing, for excursions, and as private yachts for pleasure. Since 1889 yachts have been used not only on rivers and lakes, but also on canals. The superintendent of public works of the state of New York in his report on canals for the year 1905 states that "formal written navigation permits were issued the past year to the owners of nearly one thousand such pleasure craft."[1] Many of these, however, probably had a net tonnage of less than 5, and consequently were not enumerated for 1906.

Of the steam vessels, 84, with a gross tonnage of 7,280, were operated on canals.

The decrease in number of unrigged boats is very largely due to the decrease of canal boats operating on the canals of New York state. The superintendent of public works, in his annual report on canals for the year 1906, states that "a total of ten million tons of freight could have been carried on the canals but for the single fact—a total inadequacy of seaworthy boats. There has been a constant decrease in the number of boats annually constructed during the past twelve years, and during the past five years the number of boats added to the equipment has not exceeded from six to ten in any one year. On the other hand, the older craft have been rapidly going out of commission. A careful inspection of the boats navigating the canals during the past season would have shown a very large number of those in commission so dilapidated as not to be accepted as risks by the marine insurance companies."[2] The freight carrying craft on all canals in the state in 1905 did not exceed 600 in number.[3] Another reason for the decrease in the number of canal boats is the abandonment since 1889 of several towpath canals, thus lessening the demand.

Of the total number of vessels, 1,429, having a tonnage of 188,231, were undocumented. Of these, 191, with a tonnage of 9,275, were operated by steam, and 4, with a tonnage of 25, by sail; while 1,234, with a tonnage of 178,931, were unrigged craft.

In addition to the number of the vessels for which statistics are shown in the statistical tables of this report, 68 were reported as idle during the year.

TABLE 3.—*Idle vessels: 1906.*

CLASS.	TOTAL.		DOCUMENTED.		UNDOCUMENTED.	
	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.
Total	68	7,368	15	692	53	6,676
Steam	18	651	10	311	8	340
Sail	1	10	.....	.....	1	10
Unrigged	49	6,707	5	381	44	6,326

Over four-fifths of the boats operated upon inland waters were unrigged craft, mostly canal boats, and their gross tonnage was more than nine-tenths of the gross tonnage shown, although their value was but a little more than one-half of the value of all vessels.

TABLE 4.—*Per cent that steam, sail, and unrigged vessels form of total: 1906.*

	Steam.	Sail.	Unrigged.
Number of vessels	15.7	0.7	83.6
Gross tonnage	8.3	0.2	91.5
Value of vessels	48.5	0.4	51.1
Gross income	26.9	0.1	73.0
Number of employees	30.9	0.3	68.8
Wages	30.3	0.1	69.6
Number of passengers carried	99.7	.....	0.3
Freight carried, including harbor work (net tons)	6.6	0.2	93.2

Nearly three-fourths of the gross income and over two-thirds of the employees and wages were reported by these unrigged craft. Their passenger traffic was small, the steam vessels reporting all but three-tenths of 1 per cent of all passengers carried. Practically all the freight was carried by the unrigged craft; the sailing vessels had only two-tenths of 1 per cent of it and the steam vessels only 6.6 per cent.

[1] Report on Canals of Superintendent of Public Works of the State of New York, 1905, page 16.
[2] Ibid., 1906, page 6.
[3] Ibid., 1905, page 16.

TABLE 5.—PER CENT THAT CANALS AND OTHER INLAND WATERS OF NEW YORK STATE, AND ALL OTHER INLAND WATERS, FORM OF TOTAL, FOR ALL VESSELS AND FOR EACH CLASS: 1906.

	AGGREGATE.		STEAM.		SAIL.		UNRIGGED.	
	Canals and other inland waters of New York state.	All other inland waters.	Canals and other inland waters of New York state.	All other inland waters.	Canals and other inland waters of New York state.	All other inland waters.	Canals and other inland waters of New York state.	All other inland waters.
Number of vessels	77.0	23.0	44.8	55.2	92.9	7.1	83.0	17.0
Gross tonnage	80.6	19.4	65.7	34.3	95.6	4.4	81.9	18.1
Value of vessels	71.8	28.2	62.5	37.5	95.2	4.8	80.5	19.5
Gross income	70.3	29.7	49.4	50.6	100.0	.....	78.0	22.0
Number of employees	66.3	33.7	51.2	48.8	100.0	.....	72.9	27.1
Wages	67.6	32.4	46.6	53.4	100.0	.....	76.7	23.3
Number of passengers carried	44.5	55.5	44.3	55.7	.....	.....	100.0	.....

For all but the operations of steam vessels the totals for craft on inland waters of New York had a very marked superiority over the totals for the craft on all other inland waters. Of the 2,140 vessels of all kinds reported, 1,648, or 77 per cent, were operated on the inland waters of New York. Of the different kinds, New York state reported 44.8 per cent of the steam, 92.9 per cent of the sail, and 83 per cent of the unrigged.

Of steam vessels on the New York canals, 22, with a gross tonnage of 1,552 and a value of $169,400, were used for towing. Of those on the canals of all other states, 5, with a gross tonnage of 140 and a value of $22,700, were used for the like purpose. The chief income of the New York steam vessels operating on canals—$122,946, or 53.4 per cent of the total amount reported by them—was from "all other sources;" and of this, all but $12,450 was reported by towboats. The greatest income of steam craft on canals in all other states was from the transportation of freight.

TABLE 6.—*Steam vessels operating on canals of New York state, and of all other states: 1906.*

	Total.	New York state.	All other states.
Number of vessels	84	64	20
Gross tonnage	7,280	5,757	1,523
Value of vessels	$418,800	$311,000	$107,800
Gross income	$370,191	$230,085	$140,016
Freight	$189,391	$92,325	$97,066
Passengers	$23,616	$14,814	$8,802
All other sources	$157,094	$122,946	$34,148
Number of employees	362	255	107
Wages	$145,701	$91,941	$53,760
Freight carried (net tons)	189,522	85,534	103,988

Nearly the entire number of vessels operating on the inland waters of the United States were used for commercial purposes, and more than four-fifths were unrigged craft. Except in value, all percentages shown for the commercial vessels were even greater than the percentage their number was of the whole.

TABLE 7.—ALL VESSELS AND CRAFT, BY OCCUPATION, AND PER CENT IN EACH GROUP: 1906.

OCCUPATION.	VESSELS.		TONNAGE.		VALUE OF VESSELS.		GROSS INCOME.		EMPLOYEES.		WAGES.	
	Number.	Per cent.	Gross tons.	Per cent.	Amount.	Per cent.	Amount.	Per cent.	Number.	Per cent.	Amount.	Per cent.
Total	2,140	100.0	259,491	100.0	$4,586,791	100.0	$3,957,729	100.0	3,731	100.0	$1,361,030	100.0
Commercial vessels	2,039	95.3	257,309	99.2	4,076,269	88.9	3,934,632	99.4	3,599	96.5	1,317,275	96.8
Freight and passenger	170	7.9	16,803	6.5	1,283,987	28.0	713,020	18.0	737	19.8	237,830	17.5
Ferryboats	5	0.2	307	0.1	86,500	1.9	35,150	0.9	17	0.5	8,154	0.6
Tugs and other towing vessels	75	3.5	2,733	1.1	361,464	7.9	293,452	7.5	278	7.5	124,015	9.1
Unrigged craft	1,789	83.6	237,466	91.5	2,344,318	51.1	2,888,010	73.0	2,567	68.8	947,276	69.6
Yachts	85	4.0	1,476	0.6	474,872	10.4	640	(1)	100	2.7	31,891	2.3
All other	16	0.7	706	0.3	35,650	0.8	22,457	0.6	32	0.9	11,864	0.9

[1] Less than one-tenth of 1 per cent.

The few vessels reported besides those classified as commercial, were yachts used for pleasure, and "all other" kinds of vessels, which class was made up of craft used for the inspection, repair, and care of rivers and canals, and craft for pleasure and other purposes.

NUMBER AND TONNAGE OF VESSELS.

The limit of gross tonnage per vessel of all kinds was in the group of vessels having from 1,000 to 2,499 tons. In this group there were 4 vessels, divided between steam and unrigged craft; and they were all employed in New York waters. For "all other inland waters" the limit was in the group of vessels of from 400 to 499 tons. The largest number of vessels of all kinds was in the group having from 100 to 199 tons, and the next, in that having from 5 to 49. Most of the steam vessels—66.5 per cent—had a gross tonnage of from 5 to 49 tons; the largest proportion of unrigged craft—73.2 per cent—was reported in the 100 to 199 group.

"All other inland waters" exceeded "canals and other inland waters of New York state" in number of steam and unrigged vessels in the lowest tonnage group. The only sail vessel reported for "all other inland waters" was also in this group.

TABLE 8.—VESSELS GROUPED ACCORDING TO GROSS TONNAGE: 1906.

DIVISION AND CLASS.	TOTAL.		5 TO 49 TONS.		50 TO 99 TONS.		100 TO 199 TONS.		200 TO 299 TONS.		300 TO 399 TONS.		400 TO 499 TONS.		500 TO 999 TONS.		1,000 TO 2,499 TONS.	
	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.
Total	2,140	259,491	271	5,184	255	20,505	1,371	164,817	187	43,435	32	11,002	13	5,319	7	4,634	4	4,595
Steam	337	21,507	224	4,041	41	2,980	59	7,681	6	1,440	2	667	1	469	2	1,634	2	2,595
Sail	14	518	10	126	2	183	2	209										
Unrigged	1,789	237,466	37	1,017	212	17,342	1,310	156,927	181	41,995	30	10,335	12	4,850	5	3,000	2	2,000
Canals and other inland waters of New York state	1,648	209,152	105	1,990	193	16,244	1,153	136,313	174	40,676	1	300	11	4,400	7	4,634	4	4,595
Steam	151	14,127	80	1,523	17	1,145	45	5,924	4	1,006	1	300			2	1,634	2	2,595
Sail	13	495	9	103	2	183	2	209										
Unrigged	1,484	194,530	16	364	174	14,916	1,106	130,180	170	39,670			11	4,400	5	3,000	2	2,000
All other inland waters	492	50,339	166	3,194	62	4,261	218	28,504	13	2,759	31	10,702	2	919				
Steam	186	7,380	144	2,518	24	1,835	14	1,757	2	434	1	367	1	469				
Sail	1	23	1	23														
Unrigged	305	42,936	21	653	38	2,426	204	26,747	11	2,325	30	10,335	1	450				

OWNERSHIP OF VESSELS.

Nearly two-thirds of the number and tonnage of all craft used for purposes of transportation on all inland waters of the country were under individual ownership. Incorporated companies were next most extensive in their ownership.

All the sailing vessels belonged to individuals. When the steam and unrigged are considered, a greater proportion of the latter than of the former is found to have been owned by individuals, although the difference is not great.

TABLE 9.—*Number, gross tonnage, and value of vessels, by character of ownership, with per cent in each class: 1906.*

OWNERSHIP.	VESSELS.		TONNAGE.		VALUE OF VESSELS.	
	Number.	Per cent.	Gross tons.	Per cent.	Amount.	Per cent.
Total	2,140	100.0	259,491	100.0	$4,586,791	100.0
Individual	1,328	62.1	160,359	61.8	2,320,100	50.6
Firm	83	3.9	7,993	3.1	125,200	2.7
Incorporated company	696	32.5	88,331	34.0	2,064,641	45.0
Miscellaneous	33	1.5	2,808	1.1	76,850	1.7

TABLE 10.—NUMBER AND GROSS TONNAGE OF VESSELS, BY CHARACTER OF OWNERSHIP AND BY OCCUPATION: 1906.

CLASS AND OCCUPATION.	TOTAL.		INDIVIDUAL.		FIRM.		INCORPORATED COMPANY.		MISCELLANEOUS.	
	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.	Number of vessels.	Gross tonnage.
Total	2,140	259,491	1,328	160,359	83	7,993	696	88,331	33	2,808
Steam	337	21,507	191	8,557	22	858	114	11,698	10	394
Freight and passenger	166	16,477	85	6,046	12	618	66	9,577	3	236
Tugs and other towing vessels	75	2,733	28	1,035	5	59	38	1,519	4	120
Ferryboats	5	307			1	5	4	302		
Yachts	75	1,284	69	1,226	2	15	2	19	2	24
All other	16	706	9	250	2	161	4	281	1	14
Sail	14	518	14	518						
Freight and passenger	4	326	4	326						
Yachts	10	192	10	192						
Unrigged	1,789	237,466	1,123	151,284	61	7,135	582	76,633	23	2,414

Among the freight and passenger steam vessels the largest number were owned by individuals, but a greater amount of the gross tonnage belonged to corporations.

Corporation ownership was reported more numerously than that of any other kind for tugs and other towing vessels, both as to number and as to tonnage.

TABLE 11.—*Unrigged vessels, by occupation, with per cent each class is of total: 1906.*

OCCUPATION.	Number of vessels.	Per cent.	Gross tonnage.	Per cent.	Value of vessels.	Per cent.
Total	1,789	100.0	237,466	100.0	$2,344,318	100.0
Canal boats	1,566	87.5	198,247	83.5	1,821,822	77.7
All other	223	12.5	39,219	16.5	522,496	22.3

Canal boats are the chief kind included in unrigged craft; their number was larger in proportion to the total than their gross tonnage or value.

The unrigged craft other than canal boats consisted for the most part of scows—some of which were used as lighters—barges, and dredges. This class also included pile drivers and some ferryboats.

CONSTRUCTION.

The steel vessels were few. They had their rise in the experiments with steel vessels in 1895. One steamer and five consorts took a cargo of street car rails from Cleveland to New York city, and returned with sugar for Cleveland, Indianapolis, and St. Louis. Fierce storms were encountered on Lake Erie, but the vessels rode them out. On the second trip down they carried rails for Staten Island and flour for Ireland. More gales were experienced on Lake Erie, but practically no damage was done. The best time made by the boats was thirteen days from New York to Cleveland. So pleased were the owners that three additional fleets were ordered. The towing boat was a propeller, with an engine of 120 horsepower and a net tonnage of 130. The boats were 98 feet long and 17 feet 11 inches wide, with a depth of 10 feet. The consorts had a net tonnage of 235, and were loaded to a draft of 6 feet.[1] These original vessels are now in operation at Manila, P. I.

[1]Annual Report of State Engineer and Surveyor of the State of New York, 1895, page 21ff.

TABLE 12.—NUMBER, GROSS TONNAGE, AND VALUE OF VESSELS, BY CHARACTER OF CONSTRUCTION: 1906 AND 1889.

CLASS AND OCCUPATION.	Census.	TOTAL.			IRON AND STEEL.			WOOD.			COMPOSITE.		
		Number of vessels.	Gross tonnage.	Value of vessels.	Number of vessels.	Gross tonnage.	Value of vessels.	Number of vessels.	Gross tonnage.	Value of vessels.	Number of vessels.	Gross tonnage.	Value of vessels.
Total	1906	2,140	259,491	$4,586,791	22	6,705	$767,315	2,112	252,598	$3,800,176	6	188	$19,300
	1889	6,575	996,629	6,138,914	6	1,404	109,000	6,569	995,225	6,029,914			
Steam	1906	337	21,507	2,225,673	12	5,103	673,325	320	16,319	1,533,848	5	85	18,500
	1889	163	19,223	790,000	6	1,404	109,000	157	17,819	681,000			
Freight and passenger	1906	166	16,477	1,281,737	5	4,386	489,625	161	12,091	792,112			
	1889	150	18,174	690,500	6	1,404	109,000	144	16,770	581,500			
Tugs and other towing vessels	1906	75	2,733	361,464	4	534	92,000	67	2,139	254,964	4	60	14,500
	1889	6	652	61,000				6	652	61,000			
Ferryboats	1906	5	307	86,500				5	307	86,500			
	1889	1	5	1,500				1	5	1,500			
Yachts	1906	75	1,284	460,322	3	183	91,700	71	1,076	364,622	1	25	4,000
	1889	3	74	19,000				3	74	19,000			
All other	1906	16	706	35,650				16	706	35,650			
	1889	3	318	18,000				3	318	18,000			
Sail	1906	14	518	16,800				14	518	16,800			
	1889	25	1,925	36,800				25	1,925	36,800			
Freight and passenger	1906	4	326	2,250				4	326	2,250			
	1889	25	1,925	36,800				25	1,925	36,800			
Yachts	1906	10	192	14,550				10	192	14,550			
	1889												
Unrigged[1]	1906	1,789	237,466	2,344,318	10	1,602	93,990	1,778	235,761	2,249,528	1	103	800
	1889	6,387	975,481	5,312,114				6,387	975,481	5,312,114			

[1] The character of construction of unrigged craft was not reported in 1889, but for purposes of comparison in this table all were assumed to be of wood.

The very large decrease in the number, tonnage, and value of all vessels in 1906 as compared with 1889 is due almost wholly to the decrease in unrigged boats built of wood. There was a decided increase in the number of steam vessels, in the case of those built of iron and steel and those constructed of wood. Boats of composite construction have come into statistical existence since 1889.

TABLE 13.—*Canal boats, by character of construction: 1906.*

CONSTRUCTION.	Number of vessels.	Gross tonnage.	Value of vessels.
Total	1,566	198,247	$1,821,822
Steel	9	602	18,500
Wood	1,556	197,542	1,802,522
Composite	1	103	800

Of the canal boats, 99.4 per cent were built of wood. These represent 99.6 per cent of the gross tonnage and 98.9 per cent of the value.

The decrease in unrigged craft amounted to 72 per cent in number, and 75.7 per cent in tonnage. Of this kind of vessel, no iron and steel boats and none of composite construction were shown separately in 1889; these are presented for the first time in this report.

The increase in steam vessels of all kinds was 106.7 per cent in number, 11.9 per cent in tonnage, and 181.7 per cent in value. In steam vessels of iron and steel construction the increase in value, 517.7 per cent, was greater than the increase in value of those built of wood, 125.2 per cent; but the increase in the number of the latter, 103.8 per cent, was greater than the corresponding increase, 100 per cent, for the former. Wooden steam vessels decreased 8.4 per cent in tonnage although they increased in number and value. The only iron and steel vessels shown in 1889 were freight and passenger vessels; by 1906 the number of these vessels had decreased by one, but the tonnage and value had increased largely.

The average value per vessel and average value per ton were greater in 1906 than in 1889 for vessels of all kinds, and in all particulars for such as were of iron or steel construction.

TABLE 14.—AVERAGE GROSS TONNAGE AND VALUE PER VESSEL AND AVERAGE VALUE PER TON: 1906 AND 1889.

CLASS AND OCCUPATION.	Census.	TOTAL.			IRON AND STEEL.			WOOD.			COMPOSITE.		
		Average tonnage per vessel.	Average value per vessel.	Average value per ton.	Average tonnage per vessel.	Average value per vessel.	Average value per ton.	Average tonnage per vessel.	Average value per vessel.	Average value per ton.	Average tonnage per vessel.	Average value per vessel.	Average value per ton.
Total	1906	121	$2,143	$18	305	$34,878	$114	120	$1,799	$15	31	$3,217	$103
	1889	152	934	6	234	18,167	78	152	918	6	.....	.....	.....
Steam	1906	64	6,604	103	425	56,110	132	51	4,793	94	17	3,700	218
	1889	118	4,847	41	234	18,167	78	114	4,338	38	.....	.....	.....
Freight and passenger	1906	99	7,721	78	877	97,925	112	75	4,920	66	.....	.....	.....
	1889	121	4,603	38	234	18,167	78	116	4,038	35	.....	.....	.....
Tugs and other towing vessels	1906	36	4,820	132	133	23,000	172	32	3,805	119	15	3,625	242
	1889	109	10,167	94	.....	.....	.....	109	10,167	94	.....	.....	.....
Ferryboats	1906	61	17,300	282	.....	.....	.....	61	17,300	282	.....	.....	.....
	1889	5	1,500	300	.....	.....	.....	5	1,500	300	.....	.....	.....
Yachts	1906	17	6,138	358	61	30,567	501	15	5,136	339	25	4,000	16
	1889	25	6,333	257	.....	.....	.....	25	6,333	257	.....	.....	.....
All other	1906	44	2,228	50	.....	.....	.....	44	2,228	50	.....	.....	.....
	1889	106	6,000	57	.....	.....	.....	106	6,000	57	.....	.....	.....
Sail	1906	37	1,200	32	.....	.....	.....	37	1,200	32	.....	.....	.....
	1889	77	1,472	19	.....	.....	.....	77	1,472	19	.....	.....	.....
Freight and passenger	1906	82	562	7	.....	.....	.....	82	562	7	.....	.....	.....
	1889	77	1,472	19	.....	.....	.....	77	1,472	19	.....	.....	.....
Yachts	1906	19	1,455	76	.....	.....	.....	19	1,455	76	.....	.....	.....
	1889	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Unrigged	1906	133	1,310	10	160	9,399	59	132	1,265	10	103	800	8
	1889	153	832	5	.....	.....	.....	153	832	5	.....	.....	.....

The average tonnage of vessels of wooden construction diminished between 1889 and 1906, although the average value per vessel nearly doubled and the average value per ton more than doubled. The averages for iron and steel vessels were markedly greater in every respect. In wooden tugs there was a large decrease in average tonnage and average value per vessel, but an increase in value per ton. No iron or steel construction was reported for ferryboats on inland waters; the increase in wooden boats used for ferriage is large. The unrigged craft, which were mostly canal boats, show an average tonnage for 1906 considerably less than that for 1889, but the average values per vessel and per ton increased. While the average tonnage of wooden unrigged craft diminished, the average value increased.

INCOME.

As the principal business of the greater number of the vessels was the carrying of freight, it was natural that the greater part of the income—70.4 per cent—should be from that source. By far the greatest receipts were credited to towing vessels and unrigged craft.

Relatively to total receipts for each division the receipts from passenger traffic on all other inland waters were greater than the corresponding receipts for canals and other inland waters of New York state. The percentages were 14 for the former and 9.5 for the latter. Of their total income, the boats plying on New York waters received 79.1 per cent from freight; those on all other inland waters received 50.1 per cent from that source.

TABLE 15.—*Gross income—all vessels and craft, by divisions and occupation: 1906.*

DIVISION AND OCCUPATION.	Total.	Freight.	Passenger.	All other.
Total	$3,957,729	$2,787,696	$429,393	$740,640
Freight and passenger	713,020	293,686	388,370	30,964
Towing vessels and unrigged craft	3,186,462	2,489,290	7,013	690,159
All other	58,247	4,720	34,010	19,517
Canals and other inland waters of New York state	2,781,604	2,198,920	264,397	318,287
Freight and passenger	387,489	108,648	259,037	19,804
Towing vessels and unrigged craft	2,388,965	2,090,272	1,350	297,343
All other	5,150	.....	4,010	1,140
All other inland waters	1,176,125	588,776	164,996	422,353
Freight and passenger	325,531	185,038	129,333	11,160
Towing vessels and unrigged craft	797,497	399,018	5,663	392,816
All other	53,097	4,720	30,000	18,377

EMPLOYEES AND WAGES.

The number of employees on vessels formed 90.6 per cent of the total number of employees on both land and water, and their salaries and wages were 88.2 per cent of the total.

In showing number and compensation no distinction has been made between wage-earners and officers and clerks on vessels, but this segregation has been made for employees on land. Of the land force, 32.6 per cent were officers, managers, clerks, etc., and their salaries constituted 44.7 per cent of the total salaries and wages paid on land. The proportion shown for the waters of New York state is greater in the case of numbers and of salaries.

TABLE 16.—*Employees, and salaries and wages, by divisions: 1906.*

DIVISION AND EMPLOYEES.	Number of employees.	Salaries and wages.
Total	4,118	$1,543,486
On vessels	3,731	1,361,030
On land	387	182,456
Officers, managers, clerks, etc.	126	81,497
All other	261	100,959
Canals and other inland waters of New York state	2,710	1,020,715
On vessels	2,472	920,260
On land	238	100,455
Officers, managers, clerks, etc.	92	54,695
All other	146	45,760
All other inland waters	1,408	522,771
On vessels	1,259	440,770
On land	149	82,001
Officers, managers, clerks, etc.	34	26,802
All other	115	55,199

CHARACTER OF PROPULSION AND HORSEPOWER.

More than four-fifths of the steam vessels were equipped with screws, an almost necessary feature when canals are to be traversed. Stern wheelers, while few, were more numerous than side wheelers.

TABLE 17.—CHARACTER OF PROPULSION AND HORSEPOWER OF STEAM VESSELS, BY OCCUPATION: 1906.

OCCUPATION.	CHARACTER OF PROPULSION.					HORSEPOWER OF ENGINES.			
	Total.	Screw (number).	Side wheel (number).	Stern wheel (number).	All other (number).	Total.	Steam.	Gasoline.	All other.
Total	337	285	18	34	.....	28,126	26,402	1,708	16
Freight and passenger	166	129	13	24	.....	17,324	17,028	296	.....
Tugs and other towing vessels	75	68	2	5	.....	5,283	4,988	295	.....
Ferryboats	5	2	3	.....	.....	822	822	.....	.....
Yachts	75	73	.....	2	.....	4,111	3,061	1,034	16
All other	16	13	.....	3	.....	586	503	83	.....

The steam horsepower was 93.9 per cent of the total. Gasoline engines were most largely used for yachts, 25.2 per cent of the total horsepower being from engines of this character. Yachts also had the entire number of "all other" kinds of engines.

FREIGHT.

In considering the statistics of freight it must be remembered that the figures were obtained from owners and managers of craft plying either wholly or in part on the canals and other inland waterways of the states, and not from official records or clearances kept by canal or other authorities. Under Census Office methods the freight of a boat operating on canals is classified according to the waters on which the greater part of its freight is carried or the greater part of its time is spent. Thus all the freight boats operating partly on canals or other inland waterways of New York state, but carrying more freight or spending a greater part of the season on the navigable rivers or in the harbors of New York, are included under subdivisions of waters other than canals and other inland waters of New York state, as for instance, under the section on the Atlantic coast and Gulf of Mexico. The statistics, therefore, do not show separately all the freight carried on the canals and inland waterways of the state.

The amount of freight lightered is not shown in the tables. Some of this lightering was done in the different canals of New York state, and some in the harbors of New York and Buffalo. The total lighterage returned for the canals and other inland waters of New York state was 209,590 tons, and that for all other inland waters, 18,300 tons.

TABLE 18.—*Freight shipped, by commodities: 1906.*

COMMODITY.	Quantity.
Total.....net tons..	3,716,765
Canned goods.....net tons..	1,110
Cement, brick, and lime.....net tons..	79,754
Coal.....net tons..	899,593
Cotton.....net tons..	1,413
Flour.....net tons..	4,696
Fruits and vegetables.....net tons..	15,867
Grain.....net tons..	499,340
Ice.....net tons..	71,029
Iron ore.....net tons..	36,612
Lumber.....M feet..	[1] 226,752
Naval stores.....net tons..	7,729
Petroleum and other oils.....barrels..	[2] 2,630
Phosphate and fertilizer.....net tons..	7,775
Pig iron and steel rails.....net tons..	11,750
Stone, sand, etc.....net tons..	924,351
Tobacco.....net tons..	1
Miscellaneous merchandise.....net tons..	785,577

[1] Equals 369,576 net tons. [2] Equals 592 net tons.

The largest quantity of freight reported was for stone, sand, etc.; almost one-fourth of the total net tons was in this classification. Coal freights were only a little less.

The miscellaneous group, comprising salt, sulphur, sugar, etc., constituted over one-fifth of the tonnage. These three groups accounted for seven-tenths of the total. Grain and lumber, the only other commodities for which large quantities are shown, made more than one-fifth. It is probable that the boat owners did not report all of the lumber way freight east, or all of the stone and sand, and that the totals of certain other items, as for instance ice, would be considerably enlarged if credit for the commodities were not given, in accordance with the custom of the Office, to waters in which the craft carrying them were occupied the major part of the season.

Freight on inland waterways of New York.—Concerning the Delaware and Hudson canal in New York state no census figures are presented separately because the traffic is credited to the Hudson river, and statistics for the Hudson river are included in the section on Atlantic coast and Gulf of Mexico. About nine miles of the canal—from High Falls to Eddyville—were in use. The 25 canal boats of the owning company carried 117,750 tons of cement during 1906—all of it from the works of the company.

The New York state report [1] covers all freight on state canals, whether the freight was carried by boats the chief traffic of which was in other waters or by boats freighting exclusively on the canals. It does not include freights on the other inland waters of the state, as does the Census report. These differences necessarily preclude close agreement between the statistics of the two reports. The number of commodities for which quantities are given in the state report is much larger than the number shown in the Census report. In Table 19 these have been rearranged, so far as possible, in more general accordance with the classifications of the Census.

[1] Report on Canals of the Superintendent of Public Works of the State of New York, 1906, pages 235 to 241.

TABLE 19.—CANALS OF NEW YORK—FREIGHT CARRIED, BY COMMODITIES AND CANALS: 1906.[1]

COMMODITY.	Total (net tons).	Erie canal (net tons).	Champlain canal (net tons).	Oswego canal (net tons).	Cayuga and Seneca canal (net tons).	Black River canal (net tons).
Total	3,540,907	2,385,491	740,983	172,228	164,874	77,331
Coal	545,941	268,150	182,518	17,481	76,124	1,668
Flour	300	178				122
Grain	554,291	517,605	1,482	11,514	23,214	476
Ice	116,508	50,661	42,427	23,420		
Iron ore	31,446	2,348	29,098			
Lumber	672,023	442,553	204,023	14,674	42	10,731
Petroleum	98	94				4
Pig iron	15,517	14,437	1,080			
Pulp wood	171,686	3,205	127,425	37,818		3,238
Rock and superphosphate	13,903	13,833				70
Salt, domestic	154,400	95,962	433	8,967	48,801	237
Salt, foreign	180		180			
Stone, lime, and clay	910,497	710,499	94,916	40,861	5,772	58,449
Wood pulp	2,635	1,635	400			
Miscellaneous merchandise	352,082	264,331	57,001	17,493	10,921	2,336

[1] From Report on Canals of the Superintendent of Public Works of the State of New York, 1906.

Over two-thirds of the traffic was on the Erie canal and more than one-fifth on the Champlain. The Oswego and the Cayuga and Seneca had about one-tenth between them, the Black River canal coming last with the residue.

Table 20 shows how the way and the through freight was distributed, by canals.

Table 21, from the state report, shows the quantity of the freight that went down the Hudson river to New York city.

TABLE 20.—*Canals of New York—way and through freight: 1906.*[1]

CANAL.	Total (net tons).	Way (net tons).	Through (net tons).
Total	3,540,907	2,534,493	1,006,414
Erie	2,385,491	1,713,350	672,141
Champlain	740,983	406,710	334,273
Oswego	172,228	172,228	
Cayuga and Seneca	164,874	164,874	
Black River	77,331	77,331	

[1] From Report on Canals of the Superintendent of Public Works of the State of New York, 1906, page 6.

TABLE 21.—*Canals of New York—freight to New York city, by commodities: 1906.*[1]

COMMODITY.	Quantity (net tons).
Total	953,202
Coal	230
Grain	290,513
Ice	93,072
Iron ore	29,643
Lumber	231,165
Pig iron	12,942
Stone, lime, and clay	104,118
Miscellaneous merchandise	191,519

[1] From Report on Canals of the Superintendent of Public Works of the State of New York, 1906, pages 280 to 284.

The Bureau of the Census has taken as the foundation of its discussion of the quantity and kind of freight carried on the Great Lakes, the statistics given by the Bureau of Statistics of the Department of Commerce and Labor, in order not to duplicate the work. There is, therefore, in the absence of individual census schedules of craft giving statistics of traffic by ports, no way of ascertaining what freight, if any, entered the Erie canal in boats the operations of which are included in the section on the Great Lakes.

The disparity between the totals for the Erie canal in the Census returns and those in the New York state report is largely attributable, it is believed, to differences in statistical methods.

The total traffic in the Erie canal is given in Table 22, which shows data for the freight going over the canal but included in the statistics for Atlantic coast and Gulf of Mexico and for freight carried on the canals and other inland waters of New York state, and compares the totals with those shown in the New York state report.

Table 23 shows the aggregate for the freight traffic of "canals and all other inland waters of New York state" and the freight carried on all such waters in the state, the operations of which are included in the statistics of transportation for the Atlantic coast and Gulf of Mexico.

The Census report of traffic over the Hudson river in 1906 to and from the New York canals shows a movement of 2,046,145 tons, this amount being included in the statistics for canals and other inland waters of New York state.

TABLE 22.—*Erie canal—freight, by commodities: 1906.*

COMMODITY.	CENSUS REPORT.			
	Total (net tons).	Canals and all other inland waters of New York state (net tons).	Atlantic coast and Gulf of Mexico (net tons).	New York state report (net tons).
Total	1,523,461	1,473,612	49,849	2,385,491
Canned goods	1,000	1,000	.....	[1]
Cement, brick, and lime	28,680	16,595	12,085	[2]
Coal	176,040	174,649	1,391	268,150
Flour	277	277	.....	178
Fruits and vegetables	5,709	5,709	.....	.....
Grain	466,690	460,714	5,976	517,605
Ice	35,314	16,447	18,867	50,661
Iron ore	659	659	.....	2,348
Lumber	174,925	174,925	.....	442,553
Naval stores	5,214	5,214	.....	.....
Petroleum and other oils	462	462	.....	94
Phosphate and fertilizer	4,504	4,504	.....	13,833
Pig iron and steel rails	10,788	9,918	870	14,437
Stone, sand, etc	246,519	242,039	4,480	710,499
Miscellaneous merchandise	366,680	360,500	6,180	365,133

[1] Probably included in miscellaneous merchandise.
[2] Probably included in "stone, lime, and clay," the New York classification, equivalent to the Census classification, "stone, sand, etc."

TABLE 23.—*Canals and other inland waters of New York state—freight, by commodities: 1906.*

COMMODITY.	Total (net tons).	Canals and all other inland waters of New York state (net tons).	Atlantic coast and Gulf of Mexico (net tons).
Total	2,584,722	2,502,891	[1] 81,831
Canned goods	1,000	1,000	.....
Cement, brick, and lime	89,739	77,464	12,275
Coal	472,657	453,709	18,948
Flour	277	277	.....
Fruits and vegetables	15,546	15,546	.....
Grain	472,953	466,977	5,976
Ice	90,118	68,059	22,059
Iron ore	37,867	36,612	1,255
Lumber	318,849	317,440	1,409
Naval stores	7,526	7,526	.....
Petroleum and other oils	462	462	.....
Phosphate and fertilizer	7,775	7,775	.....
Pig iron and steel rails	12,414	11,370	1,044
Stone, sand, etc	342,703	335,176	7,527
Miscellaneous merchandise	714,836	703,498	11,338

[1] In addition there were 117,500 tons of cement carried on the Delaware and Hudson canal, a waterway not owned by the state, and statistics for which, therefore, are not given in the New York state report.

TABLE 24.—HUDSON RIVER AND NEW YORK CITY—FREIGHT TO AND FROM NEW YORK CANALS, BY COMMODITIES: 1906.

COMMODITY.	Aggregate traffic (net tons).	TOTAL (NET TONS).		NEW YORK CITY (NET TONS).		ALL OTHER HUDSON RIVER PORTS (NET TONS).		ALL OTHER PORTS (NET TONS).	
		Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
Total	2,046,145	1,070,881	975,264	834,706	425,309	21,657	18,534	214,518	531,421
Canned goods	75	.....	75	.....	75	.....	.....	.....	.....
Cement, brick, and lime	72,642	54,816	17,826	50,878	9,791	440	3,790	3,498	4,245
Coal	500,592	196,719	303,873	39,514	120,198	7,876	9,241	149,329	174,434
Flour	170	170	.....	170	.....	.....	.....	.....	.....
Fruits and vegetables	7,468	7,284	184	7,284	75	.....	.....	.....	109
Grain	364,652	362,681	1,971	360,739	1,191	1,440	.....	502	780
Ice	29,849	26,999	2,850	26,199	.....	800	2,850	.....	.....
Iron ore	18,803	17,778	1,025	846	.....	200	.....	16,732	1,025
Lumber	325,390	205,956	119,434	200,369	8,757	3,225	492	2,362	110,185
Naval stores	9,138	1,612	7,526	.....	7,497	.....	.....	1,612	29
Petroleum and other oils	466	424	42	.....	42	.....	.....	424	.....
Phosphate and fertilizer	7,615	2,283	5,332	154	5,178	.....	.....	2,129	154
Pig iron and steel rails	8,820	6,791	2,029	5,931	1,054	.....	.....	860	975
Stone, sand, etc	121,656	60,735	60,921	29,310	56,519	2,270	1,463	29,155	2,939
Miscellaneous merchandise	578,809	126,633	452,176	113,312	214,932	5,406	698	7,915	236,546

The greatest quantities of freight reported are those of coal, grain, and lumber. The column of receipts may be taken to be the freight coming East, and naturally grain and lumber, largely the production of the West, preponderate. Just as naturally, if "shipments" are taken to be freight going West, the greatest quantities shipped from the East are shown for miscellaneous merchandise—sulphur, emery ore, sugar, tin, rosin, asphalt, alum, etc.—and for coal.

A knowledge of the freight carried on the Hudson river, from whatever port derived or to whatever port sent, is of interest and value. To obtain this, the traffic to and from all Hudson river ports, and the traffic to and from the canals shown in the statistics for the Atlantic coast and Gulf of Mexico, must be added to the traffic shown in Table 24, which includes only the freight passing up and down the river to and from the canals included in canals and other inland waters of New York state. Freight to or from New York city is not included in this statement of Hudson river traffic unless shipped to, or sent from, Hudson river ports.

Care has been taken not to duplicate the statistics. Freight up the Hudson from all ports, including New York city, outside the river limits is given as received at the various destinations; freight from any river port to outside ports is shown among shipments. The comparatively small quantities shipped from one river port to another are included as receipts to prevent duplication. The figures, therefore, while giving the entire river traffic, can not be used to show with absolute accuracy the traffic by ports.

TABLE 25.—*Hudson river traffic: 1906.*

SOURCE.	Net tons.
Total	8,654,880
To and from New York canals (included in canals and other inland waters of New York state)	2,046,145
To and from New York canals (included in Atlantic coast and Gulf of Mexico)	81,831
To and from river ports (included in Atlantic coast and Gulf of Mexico)	6,526,904

Substantially all of the 81,831 tons of freight which passed through the canals, and which are included in the statistics for the Atlantic coast and Gulf of Mexico, went up or down the Hudson river; a very little of it was way freight shipped from one point on the canals and received at another. There were 2,046,145 tons received from or shipped to New York canal points by way of the Hudson river, as given in Table 24. In the statistics for the Atlantic coast and Gulf of Mexico are included 6,526,904 tons shipped from, or received at, Hudson river ports, but having no connection with the canals.

The receipts and shipments of freight, by commodities, are shown for the Hudson river in Table 26. This traffic includes freight to and from New York canals.

TABLE 26.—*Hudson river receipts and shipments of freight, by commodities: 1906.*

COMMODITY.	Total (net tons).	Received from river, canal, and outside ports (net tons).	Shipped to all canals and outside ports (net tons).
Total	8,654,880	1,751,255	6,903,625
Canned goods	16,322	8,755	7,567
Cement, brick, and lime	2,039,452	103,606	1,935,846
Coal	1,079,712	417,732	661,980
Flour	7,657	6,926	731
Fruits and vegetables	31,029	14,212	16,817
Grain	370,861	362,681	8,180
Ice	1,298,124	28,199	1,269,925
Iron ore	21,134	17,778	3,356
Lumber	571,437	211,876	359,561
Naval stores	9,138	1,612	7,526
Petroleum and other oils	519	424	95
Phosphate and fertilizer	8,907	3,575	5,332
Pig iron and steel rails	28,429	14,950	13,479
Stone, sand, etc	1,836,481	107,488	1,728,993
Tobacco	63	.....	63
Miscellaneous merchandise	1,335,615	451,441	884,174

Freight on inland waterways of states other than New York.—Freight carried on canals and other inland waterways of states exclusive of New York amounted to 1,213,874 net tons. None of it was reported from New England. All the major geographic divisions of the country, except the South Central division, were, however, represented. The South Central division is not shown in this part of the report, because the canals within its borders are ship canals and consequently they are included elsewhere.

The North Central division had a little more than one-half of the total traffic and the North Atlantic (exclusive of New York, it should be remembered) over one-fourth. The South Atlantic had about one-sixth. The Western division was last, with less than one-fifteenth.

Nearly one-half of the freight carried was stone, sand, etc., coal being the next in quantity. The transportation of the former was almost altogether in the North Central division, Illinois being the chief state in the showing. The coal was carried in about equal quantities on the waterways of the North Atlantic and South Atlantic divisions, the states most largely represented being New Jersey in the former and Maryland in the latter. All the cotton shown was carried on Ohio canals; all the pig iron and steel rails reported, on the waterways of Pennsylvania; and all the tobacco, a solitary ton, on the waterways of Minnesota. Practically all the naval stores were among the freights of Florida.

The analysis is by states, arranged according to their order in the geographic divisions. In some instances a more comprehensive discussion than is afforded by the material in the table itself is given, based upon additional information obtained elsewhere.

TABLE 27.—FREIGHT CARRIED ON CANALS AND OTHER INLAND WATERS OF STATES EXCLUSIVE OF NEW YORK, BY COMMODITIES AND BY DIVISIONS AND STATES: 1906.

DIVISION AND STATE.	Total (net tons).	Canned goods (net tons).	Cement, brick, and lime (net tons).	Coal (net tons).	Cotton (net tons).	Flour (net tons).	Fruits and vegetables (net tons).	Grain (net tons).	Ice (net tons).	Lumber (net tons).	Naval stores (net tons).	Petroleum and other oils (net tons).	Pig iron and steel rails (net tons).	Stone, sand, etc. (net tons).	Tobacco (net tons).	Miscellaneous merchandise (net tons).
United States	1,213,874	110	2,290	445,884	1,413	4,419	321	32,363	2,970	52,136	203	130	380	589,175	1	82,079
North Atlantic division	314,631	.....	.....	212,584	.....	.....	.....	.....	.....	.....	.....	.....	380	91,176	.....	10,491
New Jersey	203,575	.....	.....	140,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	61,221	.....	2,354
Pennsylvania	111,056	.....	.....	72,584	.....	.....	.....	.....	.....	.....	.....	.....	380	29,955	.....	8,137
South Atlantic division	201,150	50	.....	200,000	.....	40	150	60	20	100	200	.....	.....	.....	.....	530
Maryland	200,000	.....	.....	200,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
West Virginia	500	50	.....	.....	.....	40	.....	60	20	100	.....	.....	.....	.....	.....	230
Florida	650	.....	.....	.....	.....	.....	150	.....	.....	.....	200	.....	.....	.....	.....	300
North Central division	620,841	60	82	33,300	1,413	4,229	51	30,492	2,950	2,836	3	106	.....	497,997	1	47,321
Ohio	84,098	4	5	.....	1,413	10	5	.....	2,950	294	3	56	.....	55,000	.....	24,358
Illinois	449,580	.....	.....	1,300	.....	4,147	.....	14,353	.....	.....	.....	.....	.....	425,397	.....	4,383
Michigan	18,342	50	60	.....	.....	60	.....	.....	.....	.....	.....	12	.....	17,600	.....	560
Wisconsin	30,900	.....	.....	32,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7,900
Minnesota	9,357	6	17	.....	.....	12	46	15	.....	2,172	.....	38	.....	.....	1	7,050
North Dakota	19,564	.....	.....	.....	.....	.....	.....	16,124	.....	370	.....	.....	.....	.....	.....	3,070
Western division	77,252	.....	2,208	.....	.....	150	120	1,811	.....	49,200	.....	24	.....	2	.....	23,737
Montana	3,065	.....	.....	.....	.....	.....	.....	1,624	.....	.....	.....	.....	.....	.....	.....	1,441
Arizona	4,800	.....	700	.....	.....	.....	.....	175	.....	600	.....	.....	.....	.....	.....	3,325
Idaho	40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40
Washington	54,814	.....	.....	.....	.....	150	120	12	.....	47,850	.....	24	.....	2	.....	6,656
Oregon	14,533	.....	1,508	.....	.....	.....	.....	.....	.....	750	.....	.....	.....	.....	.....	12,275

New Jersey.—All the freight tabulated by the waterways of this state went over the Delaware and Raritan canal, and it was less than that reported by the canal company. Doubtless a part of the freight returned to the Census agents by boat owners and managers is included in the statistics for the Atlantic coast and Gulf of Mexico, the boats passing into those waters and perhaps having their chief traffic therein. No traffic is shown in the Census returns for the Morris canal, the freight on this canal also probably being incorporated with that of the larger division mentioned.

Freight on canals of New Jersey: 1906.

CANAL.	Census (net tons).	Canal company (net tons).
Total	203,575	513,043
Delaware and Raritan	203,575	424,986
Morris	.....	88,057

The freight reported for New Jersey was very largely coal and nearly one-third was stone, sand, etc.

Pennsylvania.—The Census returns for this state show a total of 111,056 tons of freight transported on the canals, while the returns from the canal companies show a total of 294,979 tons. The difference is due to the difference in methods of statistical distribution and tabulation. The Lehigh Coal and Navigation Company's coal coming down its canal was taken over the Delaware river to Philadelphia, and is credited in the Census returns to transportation on the Atlantic coast. The entire traffic on this canal was reported to be coal. On the Schuylkill Navigation Company's canal the greater part of the freight was coal, 55,884 tons of coal being returned, with 29,711 tons of stone, sand, etc., 8,137 tons of miscellaneous merchandise, and 380 tons of pig iron and steel rails.

Freight on waterways of Pennsylvania: 1906.

CANAL.	Census (net tons).	Canal company (net tons).
Total	111,056	294,979
Lehigh Coal and Navigation Company	16,944	240,625
Schuylkill Navigation Company	94,112	54,354

In addition to the canal freight shown in the statement, there is a vast traffic on the Allegheny, Monongahela, and Ohio rivers in Pennsylvania, emanating largely from Pittsburg. The amount of freight carried on these canalized rivers is included, according to the report of the Census Office, in the returns for the Mississippi river and its tributaries. The report of the Chief of Engineers, U. S. Army, shows that over 16,000,000 tons of freight were carried on the Allegheny, Monongahela, and Ohio rivers.

It is stated that the annual freight traffic in the Pittsburg district exceeds 86,000,000 tons, and by far the largest portion of it consists of products particularly adapted to water transportation.[1]

[1] C. H. Forbes-Lindsay, "The Revival of the Waterway," in The World To-day for May, 1908, pages 497 and 498.

Delaware.—The Chesapeake and Delaware canal is a ship canal and the traffic on it, therefore, is not shown in this section of the report. According to the report of the canal company operating it, the freight carried in 1906 aggregated 683,086 tons. Part of the canal is in Maryland and extends from the boundary line of the state to Chesapeake bay.

Maryland.—The canal traffic, except that on the small part of the Chesapeake and Delaware canal that lies within the state, is over the Chesapeake and Ohio canal, and, as reported to the Census agents both by boat owners and by the canal company, consisted entirely, in 1906, of the transportation of coal. The boat owners reported 200,000 tons, the canal company 225,143. There may have been a difference in the time covered by the operations of boats and that by the report of the company.

Virginia.—The canals in this state are ship canals—the Albemarle and Chesapeake, extending from Norfolk, Va., to Albemarle Sound, N. C., and the Lake Drummond, or Dismal Swamp, from Elizabeth river, Va., to Pasquotank river, N. C.—both owned by canal companies. The traffic figures are reported by the canal companies as a total of 95,269 tons on the former and of 340,135 tons on the latter, an aggregate of 435,404 tons. The Census figures are in the Atlantic coast and Gulf of Mexico section of this report.

West Virginia.—There are no canals in this state, but a little traffic was reported on a canalized river, the Monongahela. Nearly one-half of the 500 tons was miscellaneous merchandise. Of lumber, there were 100 tons and of grain, 60. Canned goods, flour, and ice made up the balance of the freight. The traffic on the canalized rivers of West Virginia, except as above given, is included in the section on the Mississippi river and its tributaries. The traffic on the Great Kanawha for the year ending June 30, 1905, is given by the Chief of Engineers, U. S. Army, as 1,613,889 tons, and that on the Little Kanawha as 106,510 tons.

Georgia.—The canal traffic in this state is limited to the Augusta canal, owned by the city of Augusta. It is denominated a ship canal, and therefore is not within the limitations of the statistics shown in this section of the report. The canal owner reported that 7,004 tons of freight passed through it in 1906.

Florida.—The traffic reported for the inland waters of Florida was a matter of 650 tons, all of which were carried on the Kissimmee river. Besides miscellaneous merchandise, the commodities reported for this state were naval stores and fruits and vegetables.

Ohio.—The traffic on the Muskingum river improvement is not shown here, nor that on the Ohio canal and its branches. For the former the Chief of Engineers, U. S. Army, reported freight carried to the amount of 50,668 tons for the year ending June 30, 1905. The entire quantity shown in "canals and other inland waters" for this state amounted to 84,098 tons, all of which were returned by boats operating on the Miami and Erie canal. The state canal office reported 8,818 tons on the Ohio and branches and 75,234 tons on the Miami and Erie, with about 7,000 additional tons (as estimated) for which no weight was returned.

Illinois.—Most of the freight reported as carried on the canals of Illinois was returned by boats operating on the Chicago Drainage and Ship canal, transporting principally stone, sand, etc., these articles constituting 94.6 per cent of the total. Grain was the commodity carried in next greatest quantity, while miscellaneous merchandise, flour, and coal followed in the order named. The total traffic reported was nearly 500,000 net tons.

Freight on waterways of Illinois: 1906.

CANAL.	Census (net tons).	Canal company (net tons).	CANALIZED RIVER.	Report of Chief of Engineers, U. S. A. (net tons).
Total	449,580	6,470	Total	33,178
Illinois and Michigan	3,500	6,470	Galena	4,245
Chicago Drainage and Ship	446,080	(1)	Illinois	24,943
			Wabash	3,990

[1] Not reported.

The traffic on the Illinois and Michigan canal was, as reported, wholly in grain, leaving the rest of the grain and all the other commodities credited to the Chicago Drainage and Ship canal.

For the Illinois and Mississippi Government canal 699 tons were reported by the Chief of Engineers, U. S. Army, as transported in 1906.

Michigan.—There are none but Government canals in Michigan, and the traffic on these canals is not shown in this section of the report. The freight reported on the inland waters of Michigan was for a lake, and for a river tributary to Lake Michigan. For no other section of the country but the section covered by the Great Lakes is the traffic on navigable rivers included with the traffic on "canals and other inland waters." On Leelanau Lake 382 tons were transported and on Saginaw river 17,960 tons, the total being 18,342 tons. Building materials were the commodities shown in largest quantity and exclusively on the Saginaw river. The lake traffic was quite limited, the largest part consisting of miscellaneous merchandise. If the tonnage on the Government canals were included, the traffic would aggregate over 95,000,000 tons.

Wisconsin.—The Fox river is credited with bearing 38,650 tons of traffic, 32,000 of which were coal and the rest miscellaneous merchandise. Some of the freight was carried on Lake Winnebago exclusively, but this freight can not be segregated. The Portage canal between Fox and Wisconsin rivers is considered in the Census report as a part of Fox river. The Fox and the Chippewa rivers are both canalized. For the former the report of the Chief of Engineers,

U. S. Army, shows a tonnage of 263,589; no report is made for the Chippewa.

The Sturgeon Bay and Lake Michigan Government canal is credited with 617,210 tons.

Minnesota.—There are neither canals nor canalized rivers in this state. The traffic reported to the Census and included in this section of the report was on its lakes and on Rainy river (which is part of the boundary line between Minnesota and Canada). The other river traffic—except that on the Red River (of the North), which is given as in North Dakota—appears in the section on the Mississippi river and its tributaries.

Freight on waterways of Minnesota: 1906.

LAKE OR RIVER.	Quantity (net tons).
Total	9,357
Bass Lake	1,700
Lake of the Woods	2,111
Rainy Lake	2,050
Rainy river	2,696
Vermillion Lake	800

Of the total freight shown the greatest part was given as miscellaneous merchandise, which was about evenly distributed among Bass Lake, Lake of the Woods, and Rainy Lake. The lumber, amounting to 2,172 tons, was carried almost wholly upon Rainy river. The solitary ton of tobacco reported was transported over the Lake of the Woods. For Rainy river the largest traffic was reported—2,696 tons, including 34 tons of petroleum and other oils. All the freight on Bass, Rainy, and Vermillion lakes was returned as miscellaneous.

Iowa.—The Des Moines Rapids is a Government canal, and the traffic on it is included elsewhere. The report of the Chief of Engineers, U. S. Army, shows that 8,520 tons were transported upon it in 1906.

North Dakota.—The traffic on the Red River (of the North), the boundary between this state and Minnesota, is credited to North Dakota. There are no canalized rivers in the state, but there are navigable rivers. The freight reported for the inland waterways of North Dakota was carried on the Red River (of the North) and the Rivière des Lacs, a lake-like river in the northernmost part of the state. These are not tributary to the Mississippi river; all rivers, such as the Missouri, tributary to the Mississippi, are included in the section of the report relating to the Mississippi river and its tributaries. Of the 19,564 tons shown here as carried on the inland waters of North Dakota, 13,964 tons were reported from the Red River (of the North) and 5,600 from the Rivière des Lacs. Grain was the only commodity on the latter; and on the former it was the chief commodity, amounting to 10,524 tons, or about three-fourths of the total. A small quantity—370 tons—of lumber was carried; the remainder, or 3,070 tons, was composed of miscellaneous merchandise.

Kentucky.—For the Louisville and Portland canal, a Government canal not included in this section of the report, the report of the Chief of Engineers, U. S. Army, gives 1,053,526 tons of freight for 1906. In addition there are several canalized rivers in the state, the Government reports also giving total tonnage on these.

Freight on canalized rivers of Kentucky: 1906.

RIVER.	Quantity (net tons).
Total	729,428
Kentucky	201,510
Green and Barren	342,495
Big Sandy	148,623
Rough	36,800

Tennessee.—There are no canals in this state, but there are both navigable and canalized rivers. For the fiscal year ending June 30, 1905, 119,009 tons were carried on the Cumberland.

Alabama.—The Government canal around the Muscle shoals in the Tennessee river at Florence is credited with about 26,878 tons of freight for 1906, and the Black Warrior river with 16,281 tons.

Louisiana.—All the canals in this state are owned by corporations, and as they are classed as ship canals no returns for them are included in this section of the report on transportation by water. Nevertheless the corporations have made certain returns of tonnage.

Freight on canals of Louisiana: 1906.

CANAL.	Quantity (net tons).
Total	683,900
New Basin	500,000
Old Basin	60,000
Harvey's	50,000
Company's	50,000
Lake Borgne	23,900

The great water traffic of this state, including that on these ship canals, is shown in the section on the Mississippi river and its tributaries.

Arkansas.—For the upper White river, a canalized waterway, a tonnage of 7,999 was reported for 1906.

Texas.—There are several canals in this state, the Morris and Cummings being the only one owned by a private corporation. The statistics obtained from boat owners and managers are not included in this section of the report, but the owners of the canal reported the carriage of 2,000 tons of freight in 1906. Government canals are the Port Arthur, the Galveston and Brazos, and the Morgan; for these no statistics were secured.

Montana.—The freight on inland waterways of Montana was carried on the Flathead river and lake and the Kootenai river. It aggregated 3,065 tons, consisting of 1,624 tons of grain and 1,441 tons of miscellaneous merchandise. All the grain was carried on the Flathead river. These waters are partly navigable and are not canalized. There are no canals in the state.

Arizona.—The freight on the Colorado river in this state is included here; it amounted to 4,800 tons. The bulk of it is classed as miscellaneous merchandise; while 700 tons were cement, brick, and lime, 600 tons were lumber, and 175 tons were grain.

Idaho.—The entire quantity of freight shown for the inland waterways of this state was reported from boats operating on Lake Kaniksu. It aggregated 40 tons and is classed as miscellaneous merchandise.

Washington.—Of the 54,814 tons of freight included as transported on the inland waterways of Washington, nearly all, or 53,990 tons, is shown for the Pend d'Oreille river. From Lake Chelan 524 tons, and from Lake Whatcom 300 tons, were reported. The greatest part of the freight was lumber, of which 47,826 tons were carried on the Pend d'Oreille river and 24 tons on Lake Chelan.

Oregon.—There were 14,533 tons of freight reported for the inland waterways of Oregon. Of this, 5,625 tons were on the canalized Columbia, 8,808 tons on Lower Klamath Lake, and 100 tons on the Coquille river. The greatest part of this freight was miscellaneous merchandise, only 750 tons being lumber, and 1,508 tons cement, brick, and lime. The Portland General Electric Company has a canal around the Falls of Willamette at Oregon City. It reported 43,826 tons going through this canal in the year ending June 30, 1906. The Census figures for this canal are not included in the tables of this section of the report.

Freight on inland waterways of Oregon: 1906.

CANAL.	Canal Company (net tons).	CANALIZED RIVER OR LAKE.	Census (net tons).	Report of Chief of Engineers, U. S. A. (net tons).
Total	43,826	Total	14,533	48,911
Portland General Electric Company (around the Falls of Willamette)	43,826	Columbia river	5,625	46,884
		Coquille river	100	.....
		Lower Klamath Lake.	8,808	.....
		Yam Hill river	.....	2,027

PASSENGERS.

The 1,871,769 passengers carried by steam vessels on the inland waters of the United States in 1906 were reported from 13 states. The state of New York returned a larger total than that of any other state, although the number for Minnesota was very close to it.

TABLE 28.—*Canals and other inland waters of New York state, and all other inland waters—passengers on steam vessels, by states: 1906.*

STATE.	Total.	Regular.	Excursion.
Total	1,871,769	1,359,648	512,121
New York	828,932	580,246	248,686
California	1,200	1,200	.....
Idaho	500	500	.....
Illinois	800	.....	800
Massachusetts	35,000	35,000	.....
Michigan	96,601	16,301	80,300
Minnesota	784,648	631,236	153,412
Montana	3,287	2,419	868
North Dakota	1,835	1,835	.....
Oregon	8,119	6,119	2,000
Washington	30,067	28,440	1,627
West Virginia	10,000	8,000	2,000
Wisconsin	70,780	48,352	22,428

The 828,932 passengers carried by steam vessels on the inland waters of New York were reported from 8 waterways. It is probable that, because of the exclusion from the census of steamers of less than 5 tons net register, some passengers, both regular and excursion, have been omitted. It is likely also that in some instances care has not been taken to separate accurately regular passengers from excursionists. Some of the returns are estimates.

TABLE 29.—*Canals and other inland waters of New York state—regular and excursion passengers on steam vessels, by canals and lakes: 1906.*

CANAL AND LAKE.	Total.	Regular.	Excursion.
Total	828,932	580,246	248,686
On canals	61,049	26,799	34,250
Cayuga and Seneca canal and Lake Cayuga	19,000	12,000	7,000
Cayuga and Seneca canal and Lake Seneca	5,489	1,189	4,300
Erie canal	32,000	9,050	22,950
Oswego canal	4,560	4,560	.....
On lakes	767,883	553,447	214,436
Lake Canandaigua	39,360	27,360	12,000
Lake Cayuga	45,600	20,000	25,600
Lake Champlain	192,867	187,891	4,976
Lake Chautauqua	326,904	192,044	134,860
Lake Conesus	39,217	14,217	25,000
Lake George	106,835	106,835	.....
Lake Seneca	17,100	5,100	12,000

There were 6,120 passengers carried by unrigged craft, all in New York state: 4,120 on the Erie canal, 2,520 being regular, and 2,000, all regular, on Lake Champlain.

The Erie canal passengers were carried between Syracuse and near-by points; between Tonawanda and adjacent places; and between Schenectady, Fort Plain, and Amsterdam. The largest number of passengers carried on the inland waters of New York were reported from Lake Chautauqua, probably as a result of the educational and other assemblies held there during the summer. It is stated [1] that in 1825, the year the Erie canal was opened, the number of persons passing Utica in freight and packet boats during the season was over 40,000. At that time the railroads were not extensively in operation, and travel by canal boat offered advantages greater than those prevailing today. Notwithstanding this, in 1906 the number of passengers taken from one point to another on the canal was 36,120, 32,000 being carried by steam vessels and 4,120 by canal boats.

POWER ON CANALS.

Steam.—Although the feasibility of using steam as a motive power on the Erie canal was discussed [2] before the opening of the canal in 1825, a steam-propelled canal boat was not successfully introduced until November 17, 1870.[3] This boat went up the Hudson

[1] State of New York, Report of the State Engineer and Surveyor, Supplement, History of New York Canals, Vol. I, 1905, "Chronological Résumé of Laws and Events," page 958.
[2] Ibid., Vol. II, 1905, Bibliography, page 1339.
[3] Ibid., Vol. I, 1905, "Chronological Résumé of Laws and Events," page 966.

river and through the canal to Schenectady and returned. The first steamer began to ply on the Erie canal the year following. In 1874 there were 15 steamers in operation; in 1883 there were 92. In 1891, however, only 29 were in active service.[1] In 1906, according to the Census returns, 64 steamers and steam canal boats were in operation on the canals of New York and 20 on the canals of other states.

Electric.—Several methods of hauling canal boats by means of electricity have been tried on the canals of New York, Pennsylvania, and Ohio; although some of them have proved successful, none has been installed for permanent operation.

The first experiment on the Erie canal was with the Hawley method in 1893, a steam propeller being fitted with electric motors, the current for which was taken from a trolley wire on the bank. Later this method was tried again and with greater success; but the banks were threatened by the churning of the water.

Another system tried was that of Richard Lamb, who used, at Tonawanda, a telpher motor, or electric motor carriage, traveling on a permanent, suspended cableway, taking the current from the cable, and towing the boats by a line, as in horse or mule towage. Passing boats exchanged motors and went on without delay.

It was stated in 1895 that the New York state authorities had agreed to conditions by which electric power could be used from the Niagara power houses at the rate of about $20 per year per horsepower.[2]

About this time, also, the Dutton electric propeller device was recommended. This device consisted of a cable of wire on posts with a connecting trolley pole on the boat to which was attached an adjustable propelling apparatus.

In 1903 a part of the Erie canal, 2,700 feet in length, at a sharp curve near Schenectady, was set aside for equipment with the Wood system.[3] A mile of double track girder rail, one rail elevated above the other, was laid back of the towpath, and on each of these monorail tracks a towing car ran. This car was 10 feet long, 2 feet wide, and about 3 feet above the rail. It had two 22-inch grooved wheels, each driven by a 40-horsepower street car motor through a set of double reduction gears. A heavy arm extending downward was equipped with springs that caused a pair of grooved wheels to press upward on the lower rail, the springs being adjusted so that the grip of the car on the track was sufficient for any reasonable traction. The current was taken from the overhead wire through a trolley arm such as is used on mining locomotives, and controlled by a series-parallel controller with a few steps and by a resistance box located at one end of the car. The voltage was 475 or 500, and one wire served for the cars on both tracks. The boats were hauled by tow ropes attached to hooks on the body of the car. It is stated that about 600 tons were hauled without any difficulty at a speed of 4¼ miles an hour. Four loaded boats were also hauled readily at about the same speed without creating a wash injurious to the banks. No trouble was experienced in passing tows, and none was to be expected with tows handled by the monorail cars, for the greater elevation of one of the tracks would enable the tow ropes to be crossed without any difficulty, since it would be easy to hold down the trolley arm of one of the motors long enough for the other to pass. While the members of the commission before whom the experiments were conducted were satisfied with the success of the scheme, they decided that it was best to wait for the completion of the barge canal before authorizing a permanent installation.

In the summer of 1907 experiments with telpher motor towage were conducted on the Lehigh Coal and Navigation Company's canal at Mauch Chunk, Pa. Vice-President Wilbur, in a letter to the Bureau of the Census under date of May 12, 1908, wrote: "The experiments were conducted sufficiently long to demonstrate the practicability of electrical towage, and also demonstrate to our own satisfaction that if our tonnage were of sufficient volume, we would be justified in making the expenditure necessary to install the system. Until, however, our tonnage reaches substantially three times what it now is, or was last year, we would not be justified in making the necessary expenditure."

The tests were conducted by Lewis B. Stillwell and H. St. Clair Putnam, and the results are given by them in "Notes on Electric Haulage of Canal Boats."[4] One object of the experiments was to determine the relative merits, for the purpose contemplated, of locomotives supplied by trolley and operating upon a track of 42-inch gauge, and a monorail system. One section of the canal was equipped with mining locomotives weighing 8 tons and having direct current motors of 28 horsepower operating on 500 volt trolley circuits. An experimental generating plant was used as a source of power supply. Another section was fitted with a monorail supported at a height of 4 feet above the ground by steel posts outside the towpath. Several traction machines or tractors were used, the heaviest weighing 7,350 pounds with instruments and crew. The electric equipment of each machine comprised one direct current 40-horsepower motor.

Four canal boats, loaded and light, in from one-boat to four-boat tows, were used in all comparative trials. In addition, the regular canal traffic was handled by the locomotives and tractors during October and November and a part of September. The average speed at

[1] State of New York, Report of the State Engineer and Surveyor, Supplement, History of New York Canals, Vol. I, 1905, "Chronological Résumé of Laws and Events," page 972.

[2] Thomas Commerford Martin, "The Utilization of Niagara," Annual report of the Smithsonian Institution, 1896, pages 230 and 231.

[3] These statements are based upon an article in the Engineering Record, vol. 48, No. 20, November 14, 1903, page 596.

[4] Proceedings of the American Institute of Electrical Engineers, March, 1908, page 303 ff.

which a team of mules draws a one-boat tow approximates 1.75 miles an hour, and does not exceed 2 miles in still water. If the current assists, the speed is greater; when the current is against the boats, the speed drops very low. With towing machines single boats were handled, both loaded and empty, at speeds exceeding 5 miles an hour; two-boat tows, at from 3.5 to 4 miles; and four-boat tows, up to 3 miles an hour, except on very sharp convex curves. There was comparatively little difference in efficiencies between the mining locomotive and the monorail tractor, with which comparisons were made.

Ohio had a short and partial service with an electric railway towing method on a section of the Miami and Erie canal from Cincinnati to Middletown, a distance of about 42 miles. This system was installed by the Miami and Erie Canal Transportation Company, to which Thomas N. Fordyce assigned a contract made with him for thirty years by the board of public works March 28, 1900, pursuant to an act of the general assembly, April 25, 1895. The contract was for an electrical installation for haulage purposes along the entire length of the canal from Toledo to Cincinnati, a distance of about 244 miles. Two and one-half years was the time set for the completion of the work between Cincinnati and Dayton, and four years for the construction and equipment of the entire system. These terms, it was alleged, were not complied with. The company became bankrupt, and the state brought a suit to oust it from the canal. This suit was pending in 1907.[1]

The haulage was by electric locomotives on a standard gauge track laid along the towpath, the center being about 6 feet from the water's edge and the whole track about 2 feet above the water level, so as to avoid the wash. The locomotives were of the four-wheel mining type and weighed about 55,000 pounds each, with a wheel base of 7 feet. They were equipped with two 80-horsepower induction motors, with double reduction gears, and three self-cooling oil transformers. The current was supplied by the Cincinnati Gas and Electric Company. Three-phase 60-cycle current at 4,200 volts was transmitted over the transportation company's line of two overhead trolley wires to a station five miles distant, where there were three 150 kilowatt 60-cycle oil-cooled transformers, including one in reserve. A generator at this station furnished the current to the Cincinnati section of the canal. The railway track was used for the return.[2]

CONGRESSIONAL APPROPRIATIONS.

Appropriations, except as herewith given for inland waterways, have been included in the other geographic divisions, such action being due in most cases to the impracticability of segregating the various amounts.

[1] Report of the Attorney-General of Ohio, January 1, 1906, to January 1, 1907, page xi.

[2] Statements based on article in the Engineering Record, previously cited.

Lake Champlain.—The first improvements on Lake Champlain were authorized by the act of July 4, 1836, which appropriated $43,000 to be used as follows: For building a breakwater, or pier, at Burlington harbor, $10,000; for the same purpose at Plattsburg harbor, $10,000; for improving the entrance to Whitehall harbor, $8,000; and $15,000 for deepening the channel between North and South Hero islands, near St. Albans. Up to and including the act of March 2, 1907, Congress has appropriated $1,347,910 for improvements at various localities on the lake. Of this amount, 84.1 per cent was appropriated up to and including the act of September 19, 1890, and the balance since that year.

The following statement shows the Congressional appropriations made for improvements on Lake Champlain, by localities:

Congressional appropriations for the survey, improvement, and maintenance of the harbors and tributary streams of Lake Champlain, by periods and localities.

LOCALITY.	Date of earliest appropriation.	APPROPRIATIONS.			
		Total.	Up to and including 1890.	1891 to 1906, inclusive.	March 2, 1907.
Total	1836	$1,347,910	$1,133,660	$211,750	$2,500
New York	1836	356,680	328,680	28,000	.....
Great Chazy river	1890	18,000	10,000	8,000	.....
Plattsburg harbor	1836	190,680	185,680	5,000	.....
Rouse Point breakwater	1884	98,500	83,500	15,000	.....
Ticonderoga river	1881	16,500	16,500	.....	.....
Whitehall harbor	1836	33,000	33,000	.....	.....
Vermont	1836	991,230	804,980	183,750	2,500
Burlington harbor	1836	699,980	582,230	117,750	.....
Gordons Landing harbor	1886	34,750	34,750	.....	.....
Lake Champlain narrows	1836	[1]123,500	76,000	45,000	2,500
Otter creek	1872	62,500	41,500	21,000	.....
Swanton harbor	1873	70,500	70,500	.....	.....

[1] Includes $31,000, appropriated for deepening the channel near St. Albans called the "Gut."

Red River (of the North) and Warroad harbor and river.—The first appropriation for the improvement of the Red River (of the North), which is the boundary separating Minnesota from North Dakota, was made in 1876. The appropriations in the statement following include appropriations for the survey of Otter Tail lake and river and Red Lake and Red Lake river. The object of the improvement is to provide an open channel from Breckenridge to the northern boundary, 395.5 miles. Navigation is now confined to comparatively short reaches north and south of Grand Forks, and consists mainly in the transportation of wheat to Grand Forks by 2 steamboats and 12 barges. Bars have been lessened by dredging; trees, snags, and bowlders have been removed, and training dikes built.

The first appropriation for Warroad harbor and river, Minnesota, was made in 1899. The outlet of Warroad river is the only natural harbor in the United States on the Lake of the Woods, which is part of the boundary between Minnesota and Canada, and almost

wholly within the latter territory. By dredging, a minimum depth of 12 feet on the bars and of 9 feet in the inner channel has been secured. Two steamboats, 4 sailing vessels, and 2 gasoline boats made regular trips to and from Warroad during the season of 1906. There are now upward of 25 steamboats, from 10 to 500 tons capacity, navigating Lake of the Woods, the greatest stretches of which are in Canada.

The statement that follows shows the data concerning Congressional appropriations for the inland waterways mentioned here:

Congressional appropriations for the survey, improvement, and maintenance of Red River (of the North) and Warroad harbor and river.

	Date of earliest appropriation.	APPROPRIATIONS.			
		Total.	Up to and including 1890.	1891 to 1906, inclusive.	March 2, 1907.
Total	1876	$421,623	$218,000	$188,623	$15,000
Red River (of the North)	1876	338,623	218,000	[1] 105,623	15,000
Warroad harbor and river	1899	83,000	.....	83,000	.....

[1] Includes appropriations for survey of Otter Tail lake and river, and Red Lake and Red Lake river.

THE DEVELOPMENT OF INLAND WATERWAYS.

The renewed activity in connection with the improvement of inland waterways makes interesting certain expressions concerning this question when canal construction was at its height in the early part of the last century.

"The state has now 720 miles of public improvements, which, in point of extent, execution, and prospective usefulness may challenge a comparison with any other structure known to modern times," said Governor Wolf of Pennsylvania in his annual message to the legislature in 1834.[1]

"The possibilities of complete connections between the internal water systems of this country, and through them with all other portions of the outer world, are bewildering. What was actually accomplished in linking the Lakes with the Hudson exceeded all rational expectations, and if plans for connecting Philadelphia, Baltimore, and Georgetown with the Ohio river had been equally successful, the utility of canals would have been greatly increased and railway progress greatly retarded. In 1833 hopes were still cherished of the completion of the Chesapeake and Ohio canal, throughout its entire length, from Georgetown to Pittsburg, and another project, frequently discussed, for which national aid was solicited, was the construction of a national steamboat canal, which would connect the Susquehanna with an avenue leading directly to the Great Lakes." [2]

[1] Mitchell's Compendium of Canals and Railroads, 1835, page 34.
[2] J. L. Ringwalt, "Development of Transportation in the United States," page 51.

"The proposals to unite the Potomac to the Ohio, Lake Michigan to the Gulf, and Pittsburg to Lake Erie, by water, lift one into the realm of large conceptions. Yet the first was advocated by Washington, the second by Madison, and the third by Calhoun; hence, at the dawn of the twentieth century, they should not be regarded as novel." [3]

That the same, or greater, enthusiasm prevails to-day is evident. At the Deep Waterway Convention at Memphis, Tenn., October 4, 1907, President Roosevelt, in the course of a comprehensive address, said: "Facility of cheap transportation is an essential in our modern civilization, and we can not afford any longer to neglect the great highways which nature has provided for us. These natural highways, the waterways, can never be monopolized by any corporation. They belong to all the people, and it is in the power of no one to take them away."

In opening the National Rivers and Harbors Congress in Washington, D. C., the same year, Secretary Root emphasized the necessity of the proposed systems of national waterways by saying: "The railroads of the country no longer are able, physically, to carry the traffic of America, and the one avenue open to such traffic is water transportation. We must move forward or we will go backward. I see American production handicapped by two things: First, the cost of getting the goods to the seaboard; and second, the absence of an American Merchant Marine."

An Inland Waterways Commission was appointed by President Roosevelt in 1907, "to recommend a full and comprehensive plan for the development and utilization of all the natural resources of the country relating to water. Its primary purpose was to facilitate water transportation, upon which the prosperity of the country so largely depends." [4] One of the great results of this appointment was the conference of governors of states and other notable delegates at the White House in May, 1908, by request of the President.

Senator Newlands, of Nevada, who is vice-chairman of this commission, is also the author of a bill for the appointment of an official Inland Waterways Commission, with power to expend, under the direction of the President, $50,000,000 annually for the next ten years in surveys and practical work for the improvement of the country's waterways.

It is Senator Newlands' opinion that "the Ohio can be connected by canal with Lake Erie, the Mississippi with Lake Michigan, and so on; and we can connect the entire Mississippi valley, the Gulf coast, and the Atlantic coast with each other by a system of sheltered waterways along the Gulf and Atlantic coasts * * * consisting of bays, sounds, and rivers to be connected

[3] Forestry and Irrigation, January, 1908, pages 8 and 9.
[4] Hon. Francis G. Newlands, "Use and Development of American Waterways," in American Waterways, American Academy of Political and Social Science, January, 1908, page 49.

with each other by canals, such as the contemplated canal across Florida, connecting the Gulf with the Atlantic coast, the canal connecting the Carolina sounds with Chesapeake bay, the canal connecting Chesapeake bay with the Delaware river, the canal connecting the Delaware river with the Raritan, and the canal across Cape Cod, thus giving a sheltered waterway from the mouth of the Mississippi to Maine, upon which it is possible that boats of standard draft could pass from Boston down the Atlantic coast, across Florida to the Gulf coast, and up the Mississippi to the Great Lakes. If these things were done, and warfare between the railways and waterways should continue, there would still be sufficient transportation, without the distributing aid of the railways, to constitute a very influential part of the commerce of the country."[1]

The country has been divided into four systems:

(1) The Atlantic Interior, comprising all territory east of the Rocky mountains.

The chief projects here are the building of one vast waterway of canals and canalized rivers from the Great Lakes to the Gulf of Mexico; and another from Boston by the Cape Cod canal, now under construction by private citizens, through Long Island Sound, New Jersey, Delaware, Virginia, Maryland, North Carolina, South Carolina, and Georgia, to the Florida rivers. Many of the connecting links are old canals and canalized rivers. Besides this, rivers and neglected streams from Maine to Texas, including the Mississippi to its headwaters and its great tributaries, are to be improved. An inner passage, also, is planned to extend from the Mississippi to the Rio Grande, and another from the Mississippi to Florida. Canals are also to connect the Great Lakes with the upper Mississippi and the Ohio, and the canal now building under private auspices from Ashtabula, Ohio, to Pittsburg, Pa., is to be completed. Among the propositions for this system are the union of Toledo with Cincinnati by a deep waterway, the joining of Toledo with Chicago by means of a barge canal, the connection of Chicago with New York by way of the Great Lakes, the Erie canal, and the Hudson, and even the junction of New York with Puget Sound. The connection of the Mississippi, Ohio, and Tennessee rivers with the Coosa, Ocmulgee, and Altamaha, thus uniting the Ohio and Mississippi systems with our southeastern coast waters at Mobile and Brunswick, respectively, is another project.

(2) The Columbia-Puget, with the improvement of the Columbia, Willamette, and Snake rivers, where much work has already been done by Federal and state governments.

(3) The California, involving principally the canalization of the San Joaquin and the Sacramento rivers.

(4) The Colorado river, with extensive projects principally for irrigation.

It is of interest to note what is being done or projected of superior importance in the various states, whether by Federal, state, or private enterprise, in the construction and improvement of inland waterways of all kinds. Statements concerning Federal enterprises are taken largely from the reports of the Chief of Engineers, U. S. Army.

NORTH ATLANTIC DIVISION.

Massachusetts.—The passage around Cape Cod is the great highway for the commerce between the northeastern and southern ports, and for many foreign vessels which touch at Boston, bound to or from New York. The idea of a canal across Cape Cod is a very old one, and as early as 1676 a cut through the peninsula was considered; although numerous surveys for a canal have been made, no actual work was ever accomplished until recently. The Boston, Cape Cod, and New York Canal Company has recently been chartered and proposes to cut a canal, without locks, 250 to 500 feet wide, and 25 feet deep at low water, across Cape Cod from Barnstable bay to Buzzards bay, a distance of 8 miles. As estimated, the cost of this waterway will be about $10,000,000, and the expectation is that it will be completed in the fall of 1911. The proposed canal will shorten the distance between Boston and New York, and eliminate the great danger from marine disaster to vessels passing around the cape.

New York.—One of the most noteworthy projects in artificial waterways is the enlargement of the Erie, Oswego, and Champlain canals, all located within, and owned and operated by, the state of New York. The expenditure for this improvement of $101,000,000, which will be the cost according to the estimates of the state engineer and surveyor, was authorized by a vote of the people at a general election. More than one-half of the new water routes will be through river channels and lakes, and the canal work involves the construction of entirely new channels and locks, in many places along different routes from the present canal.[2]

On the principal route, or the Erie canal, from Lake Erie to the Hudson river, the new channel will follow the line of the old canal, in the main, from the Niagara river at Tonawanda to the neighborhood of Lyons. Thence it will take a new route to the south of the Montezuma marshes, and in the Seneca and Oneida rivers and across Oneida Lake. Thence it will cross to the Mohawk river, west of Rome, and utilize the bed of that river for most of the distance to Waterford on the Hudson. The new route will remove the canal from the business districts of Rochester and Syracuse, and at the same time furnish each of these cities with larger and better facilities for water traffic in the Genesee river and Lake Onondaga. The most important changes of level will be at Lockport and Waterford. At the former a flight of 2 locks will replace the 5 now in use; and at the latter 5 locks, with a fall of 34 feet each, will take the place of the 16 in the neighborhood of Cohoes, on the old canal.

[1] Hon. Francis G. Newlands, "Use and Development of American Waterways," in American Waterways, American Academy of Political and Social Science, January, 1908, pages 55 and 56.

[2] John A. Fairlie, "New York Canals," in American Waterways, page 121.

In addition to this main line, the Oswego river will be canalized from its junction with the Erie canal route to Lake Ontario, furnishing a waterway from that lake to the Hudson with only 35 miles of canal. The Hudson river will also be made navigable from Troy to Fort Edward; and from there a new channel will follow the line of the Champlain canal to the lake of that name.

Work on the general project is already under way, but it is not expected that it can be finished in less than six years. When the improvement is finished, the canals are to have a minimum depth of 12 feet and a minimum bottom width of 75 feet, except when they pass through rivers or lakes, when the minimum bottom width shall be 200 feet. The locks, which are the principal factors in limiting the size of the vessels, will be 328 feet in length and 45 feet in width. These will permit the passage at one time of 2 boats, each 150 feet long and 42 feet wide, drawing 10 feet of water, and having a capacity of 1,500 tons; and such barges will be the most economical unit for transportation on the new routes. The size of the barges and the location of so much of the new routes in open water courses will involve the disappearance of the primitive system of horse towage, and will make necessary the use of steam or other mechanical motive power. It is expected that vessels will usually go in fleets of 4, one steamer towing 3 barges, and under these conditions it is estimated that the trip from Buffalo to New York can be made in five days, in place of ten days, as at present.[1]

The Rochester Chamber of Commerce, in pursuance of another project of improvement in waterways, resolved on December 2, 1907, that "the proposed 'Rochester, Pittsburg and New Orleans Waterway,' or 'The Middle Route from Lake Ontario to the Gulf of Mexico,' is worthy of careful consideration." This route was described by J. T. McClintock, county engineer of Monroe county, N. Y.,[2] who said: "It is possible to build a waterway 12 feet deep from Lake Ontario up the bed of the Genesee river, over the divide at Cuba and down the Allegheny river to Pittsburg, where it will connect with the Ohio, and then the Mississippi river to the Gulf of Mexico. The total length from Lake Ontario to New Orleans will be about 2,308 miles, and to Pittsburg 360 miles. It is apparent from information we now have that 35 locks or lifts would be sufficient to reach Pittsburg * * *. Mechanical lifts have been perfected which permit of boats being raised or lowered 100 feet or more at one lock."

New Jersey.—The Raritan river is 10 feet deep for 12 miles from its mouth to New Brunswick. Both New Jersey and Delaware have profited by the improvement of the Delaware river as far as Philadelphia. A 30-foot depth to Trenton is projected.

[1] John A. Fairlie, "New York Canals," in American Waterways, pages 122 and 123.

[2] "Waterways Development," in Proceedings of Rochester Chamber of Commerce at the regular meeting, December 2, 1907, page 14 ff.

Pennsylvania.—A ship canal to connect Pittsburg with Lake Erie is probably one of the most important projects now receiving attention. The Lake Erie and Ohio Ship Canal Company has been granted permission by Congress to construct a canal 13 feet deep, with a surface width of 177 feet, from Beaver, Pa., on the Ohio river, to Ashtabula, Ohio, on Lake Erie. The total length of this waterway is to be 103 miles, of which nearly one-half will be formed by the canalization of rivers tributary to the Ohio river. It will require from 25 to 30 locks, 400 feet long by 56 feet wide, to overcome the rise to or the fall from the summit level of the canal. It is estimated that the original cost will be $50,000,000, and that it will take five years to complete the canal after construction work has commenced. When complete it will be possible for lake vessels to carry iron ore direct from the Lake Superior mines to the furnaces along the route of the canal, and for coal to be shipped from western Pennsylvania mines to upper lake ports by an all-water route. It has been estimated that the annual traffic through the canal will not be less than 18,000,000 tons, or about one-third of the annual tonnage through St. Marys canal, and that there will be a great saving on iron, coal, and coke, the commodities whose tonnage will constitute the greater part of that through the canal. Steam whaleback vessels of the type now in use on the Great Lakes can easily pass through the canal to Pittsburg.

The Ohio river from Pittsburg, Pa., to its mouth in the Mississippi river, near Cairo, Ill., has a length of about 1,000 miles. Since 1825 the Federal Government has been at work on this river securing additional depths at islands and bars by the construction of low dams, by building dikes where the river was wide and shallow, by dredging, and by the removal of rocks and snags. In 1875–76 Congress first approved of the project of canalizing the upper part of the river to secure a low-water depth of 6 feet, by the construction of locks and dams, the first of the locks, located at Davis Island, 5 miles below Pittsburg, being completed in 1885. The next lock to be completed is located at Beaver, Pa., 29.5 miles below Pittsburg, and was placed in operation in 1904, and another lock, located between Davis Island and Beaver, was completed in 1906. At the present time the accepted project is for 6-foot navigation from Pittsburg to Aurora, Ind., just below Cincinnati, about 500 miles down the river, and contemplates the construction of 32 additional locks, of which 7 are now being constructed. To complete the canalization of the Ohio to its mouth at Cairo, Ill., would require 30 additional locks. Around the Falls of the Ohio at Louisville, Ky., about 396 miles below Pittsburg, is the Louisville and Portland canal, about 2.4 miles long, with 4 locks. This canal has been in operation for many years. The United States Government has already expended over $15,000,000 on the improvement of the Ohio, and it will take between

$25,000,000 and $30,000,000 more to complete the canalization of this river.

The Allegheny and the Monongahela rivers form the Ohio river. The Allegheny has ample width and volume for the purpose of slack-water improvement. Three locks between Pittsburg and Natrona, a distance of about 24 miles, have already been constructed, and a project has been submitted to canalize the river from its mouth to the state line, by the construction of 54 additional locks, at an estimated cost of about $13,500,000. The project, however, is to extend slack-water navigation only to Monterey, about 80 miles above Pittsburg, by the construction of 8 additional locks and dams at an estimated cost of about $2,500,000.

The improvement of the Monongahela river in Pennsylvania extends from Pittsburg to the mouth of Dunkard's creek, a distance of 87.5 miles. This makes the waterway of great use to the coal fleets, which are accustomed to wait in Pittsburg harbor for the rise in the Ohio, in order that they can proceed to points on that river and on the lower Mississippi. Several packet lines ply on the Monongahela, Ohio, and Allegheny rivers. This system of inland waterways is one of the busiest in the United States.

Another important undertaking is thus outlined: "As a link in the chain of deep waterways from Boston to Beaufort, the Delaware is of first importance. Its 30-foot channel from Philadelphia to deep water in Delaware bay will be ample until other links in the chain have been completed, and by that time it will have been further deepened. The proposed Delaware and Chesapeake Ship canal will at once put Philadelphia in communication with numerous important points on Chesapeake bay and its tributaries. The extension northward to Raritan bay involves not only the building of a ship canal, but extensive improvements in the river itself, for the channel north of Philadelphia is only 9 feet deep the greater part of the way to Bordentown. Southward from Philadelphia, to whatever point may be selected as an outlet to the Delaware and Chesapeake canal, the Delaware river is already an ample waterway for the purposes of the proposed continuous inland route. The immediate demand is for the completion of the 30-foot channel from Philadelphia to the sea; then for a survey of 35 feet, which is necessary to accommodate vessels of increased draft."[1]

SOUTH ATLANTIC DIVISION.

Delaware.—In 1901 the legislature of this state authorized the expenditure of $60,000 toward the improvement of the Christiana river at Wilmington. The entire amount has been expended and the project toward which it was applied has been completed. The state is much interested in the improvement of the Delaware river, which is described in connection with the waterways of Pennsylvania.

Maryland.—The Susquehanna river is navigable for 5 miles from its mouth, and the Patapsco for 11 miles to Baltimore. The Government has done much work on these waterways. Chesapeake bay and Baltimore harbor also have been improved. The Potomac river has a 24-foot depth to Washington. The Chesapeake and Ohio canal has been controlled since 1890 by a board of trustees appointed by the court in the interest of bondholders under the mortgage of 1844. Its traffic tonnage is almost altogether that of coal.

District of Columbia.—The Federal Government has improved the Potomac above and below Washington. The Potomac is navigable to the foot of Little Falls.

Virginia.—In Virginia the York river is 21 feet deep to West Point, a distance of 45 miles; the Rappahannock has a depth of 9 feet for 106 miles, and the James 100 miles of 17-foot channel to Richmond. The Mattapony, the Pamunkey, and the Nansemond are being improved.

West Virginia.—Slack-water navigation on the Little Kanawha river extends from its mouth at Parkersburg to Creston, a distance of 48 miles, and provides a depth of 4 feet. Four of the 5 locks now in operation were constructed by the Little Kanawha Navigation Company between 1867 and 1874, and afford slack-water navigation from Parkersburg to Spring Creek, a distance of 43 miles. The Federal Government built a lock 2 miles above Burning Springs, and it was opened to navigation in 1891. In 1905 the Federal Government purchased the navigation company's locks, and it is now proposed to continue the canalization of this river to Bulltown, about 130 miles above Parkersburg, by the construction of 11 additional locks.

The Great Kanawha river flows through a region rich in mineral wealth, especially coal. The original project for the canalization of this river was adopted in 1873, and the modified project in 1875, and the river is now canalized from Point Pleasant, where it empties into the Ohio river, to Loup Creek shoals, about 90 miles above the mouth. There are 10 locks and dams, 2 of the dams being fixed and 8 movable. The first lock and dam in this system were put in operation in 1880, and the last in 1898. Since the improvement there has been a large increase in the commerce of this river.

Before the Monongahela river in West Virginia was improved, at high water steamboat navigation was practicable only as far upstream as Morgantown. Occasionally a boat would go to Fairmont. The canalization and other improvements finished in 1899 furnished a channel 5.2 feet deep at low water as far as Morgantown. The completion later of 6 locks and dams extended slack-water navigation about 28 miles, from Morgantown to a point on the West Fork river 4 miles above Fairmont, with a minimum navigable

[1] Hon. J. Hampton Moore, M. C., "Delaware River," in American Waterways, pages 71 and 72.

depth of 7 feet. The Chief of Engineer's report, 1907, advises that "the improvement should enable the people of the territory affected to transport coal, general freight, etc., almost uninterruptedly to market." A daily line of packets plies the river between Pittsburg, Pa., and Fairmont, W. Va., and towboats run as often as required.

North Carolina.—The aim of the Federal Government is to make a channel 5 feet in depth on the Roanoke from its mouth to Weldon, a distance of 129 miles. The Tar has a channel 3 feet deep for 22 miles. The Neuse and Trent are said to be navigable to Smithfield, a distance of 150 miles, and it is expected that they will be deepened until they have a channel of 3 feet. The Cape Fear river is to be canalized and made 8 feet deep to Fayetteville, a distance of 115 miles.

South Carolina.—In this state the principal rivers are the Waccamaw and the Little Peedee, which are fairly deep for 50 miles and only 2 or 3 feet in depth for 50 miles more; the Santee, with its tributaries; the Congaree and the Wateree; and the Peedee; all of which the Appalachian Forest Reservoir system would make navigable for river steamers. Work on these waterways has been progressing for the last two or three decades.

Georgia.—The Coosa river is formed at Rome, Ga., by the junction of the Oostenaula and Etowah rivers, which have their sources in northern Georgia. The Oostenaula is formed by the junction of the Coosawattee and Connesauga rivers, 56 miles northwest of Rome. The Oostenaula and the Coosawattee are navigable for light-draft boats during nine months of the year for a distance of about 105 miles, but the Etowah and Connesauga are not navigable. The Coosa river has always been navigable for light-draft boats from Rome, Ga., to Greenport, Ala., an estimated distance of 162 miles, and this part of the river is of such a character as to make its improvement by works of contraction and channel excavation entirely practicable, except at Horseleg shoals, near Rome, where a lock of low lift will ultimately be required. From Greenport to Wetumpka, Ala., a distance of 142 miles, locks and dams are required in conjunction with works of contraction and channel excavation to provide for navigation. From Wetumpka to the junction of the Tallapoosa the river is navigable at all seasons. Various examinations and estimates for the improvement of parts of this river between Rome and Wetumpka were made up to the time of the adoption of the existing project. This project provides for a lock with excavation for a 4-foot channel between Rome and Wills creek in Alabama; for 3 locks between Greenport and Whisenant and Ten Island shoals, with an extreme low-water depth of 4 feet on miter sills, together with a 3-foot channel between locks 1 and 3; for 5 locks and dams from and including lock 4 to the East Tennessee, Virginia, and Georgia Railroad bridge, with an extreme low-water depth of 6 feet over the miter sill, together with a connecting channel 100 feet wide and 4 feet deep at extreme low water; and for 23 locks and dams, with 6 feet over the miter sills, between the East Tennessee, Virginia, and Georgia Railroad bridge and Wetumpka. In addition, the channel is to be cleared of various rock reefs and points, so as to give a minimum depth of 4 feet. The cost of these improvements is estimated at about $7,000,000. Three locks below Greenport have been built and lock 4, about 26 miles below, is under construction.

Georgia is to be one of the great beneficiaries of a projected inner canal from Cairo, Ky., to Brunswick and Savannah. A bill involving the appropriation of $75,000 for a survey of this great canal has already passed the United States Senate.

Florida.—The St. Johns river is navigable 276 miles to Lake Washington, and is 13 feet deep to Palatka. The Ocklawaha, the Kissimmee, the Caloosahatchee, the Suwanee, and the Withlacoochee also are in a projected scheme of improvement. Across the western part of the state runs the Apalachicola, navigable for its entire length of 137 miles, and leading up into the Chattahoochee and the Flint.

NORTH CENTRAL DIVISION.

Ohio.—The general assembly of Ohio recently authorized the improvement of the Miami and Erie canal, which extends from Toledo on Lake Erie to the Ohio river at Cincinnati. Previously an appropriation had been made for the enlargement of the Ohio and Erie canal between Cleveland and Dresden. The enlarged canal will have a depth of 12 feet and a width on bottom of 75 feet. The enlarged locks will be 300 feet long by 28 feet wide and have a minimum depth over the miter sill of 11 feet. The estimated cost of all these improvements is $3,000,000.

Under date of August 21, 1907, Chief Engineer Charles E. Perkins wrote to the Bureau of the Census:

"The legislature of this state has had under consideration for a number of years the improvement of its canal system, which at last resulted in an act passed April 25, 1904, 'to provide for a continuing appropriation for the improvement of the Northern Division of the Ohio and Erie canal between Cleveland and Dresden on the Muskingum slack-water improvement, a distance of 150 miles.' (See Laws of Ohio, vol. 97, page 578.) This policy since that time has been directed to the improvement of the entire Miami and Erie canal between Cincinnati and Toledo, including what is known as the Sidney feeder, a distance for the main canal of 244 miles and for the Sidney feeder of 14 miles. * * * The improvements will increase the hauling on the canals, net tons per boat, from 70 to 115. The improvement contemplates the restoration of the balance of the Miami and Erie canal from Dayton to Toledo, as it was originally built, providing for a canal prism 5 feet deep by 50 feet in width in the minimum between Dayton

and Defiance, and 60 feet in width and 6 feet deep between Defiance and Toledo. The estimated cost for improvement is practically $1,000,000 for the Ohio canal between Cleveland and Dresden and $2,000,000 for the improvement of the Miami and Erie canal." The state has already made an appropriation of $706,000 for these improvements, besides a number of minor appropriations for repairs to some of the old structures.

In a report urging the improvement of the canals, the chief engineer of public works set forth the importance of the work as follows:

"The General Government, by act of Congress, has practically recognized the commercial value of the Muskingum river improvement from Marietta on the Ohio to Zanesville, by the adoption of it as a public work, and will undoubtedly extend the improvement north as far as Dresden or Coshocton, thus providing and maintaining a waterway nearly half way across the state; and as the improvement of the Ohio canal from the terminus of the Muskingum improvement to Lake Erie would form an integral part of that great waterway and would be of joint utility with it, it would appear that it would be advisable to improve this portion of the Ohio canal, and by induction a favorable decision can be reached regarding the entire canal system. A cursory comparison of the commercial possibilities of the Muskingum improvement below either Coshocton or Zanesville with those of the Ohio canal from those points to the lake, and with the commercial possibilities of the Miami and Erie canal, with its much greater population of the territory and its more extensive industrial resources, would make the argument for the improvement of the entire canal system more forcible. In determining a future policy to be adopted for the canals of Ohio, the fact should not be overlooked that the Great Lakes bordering the state of Ohio on the north and the Ohio river bordering it on the south, rank, in the magnitude of their commerce, first and third, respectively, among the waterways and common carriers of the United States." [1]

Indiana.—At the time the United States began the work of improving the Wabash river the waterway was badly obstructed by bars, accumulations of snags, rocky reefs, and numerous secondary channels or cutoffs, which lessened the flow of water through the main channel. Navigation was impracticable except at high stages of water. A lock and dam were built at Grand Rapids by the Wabash Navigation Company in 1848 and a few improvements made at other places, also by private enterprise; but as none was of a substantial character, they rapidly deteriorated and became useless. The original project proposed the improvement of the river from its mouth to Lafayette by the general work of snagging and dredging, by special works at designated localities, and by the construction of a new lock and dam at Grand Rapids, which were opened to navigation in 1893.

Illinois.—The Chicago Drainage and Ship canal is one of the most important canals opened to navigation since 1889. This canal was built by the city of Chicago for the purpose of giving that city proper drainage facilities by reversing the movement of the water, which formerly flowed into Lake Michigan through the Chicago river, and turning a current from the lake through the Chicago river to the Illinois river at Lockport, and thence to the Mississippi river. The canal proper extends from Robey street, where it joins the Chicago river, to Lockport, a distance of 28 miles, and with the 6 miles of the Chicago river from Robey street to Lake Michigan this waterway has a total length of 34 miles. The minimum depth of the canal is 22 feet; its average width on bottom, 158 feet; and the average width at top, 244 feet. The work was commenced in 1892 and water was turned into the channel in 1900. The controlling work, consisting of a bear-trap dam 160 feet wide, with a vertical play of 17 feet, and 7 sluice gates, each 30 feet wide and having a vertical play of 20 feet, are located near Lockport. The canal cost about $52,000,000, including rights of way; bridges, all of which are movable structures; excavations, etc. It has been proposed to Congress to make this canal a commercial highway by increasing the channel depth of the Illinois and Mississippi rivers to 14 feet, with locks for fleets of barges from Lockport, the terminus of the canal, to St. Louis. This, it is argued, would afford through water transportation from Lake Michigan to the Gulf of Mexico via the drainage canal, the Illinois river, and the Mississippi river. The Chicago Sanitary District, which is the owner of the canal, offers to turn it over to the Government as a part of the greater project.

The Illinois and Mississippi canal, which is being constructed by the Federal Government, was begun in 1892, and the 3 locks and 4.5 miles of canal around the rapids of the lower Rock river at Milan were completed and opened to navigation in 1895. This canal is to extend from a short distance above Hennepin, via Bureau Creek valley and over the summit to Rock river at the mouth of Green river; thence by slack water in Rock river to the canal at Milan, and from that point to the Mississippi river at the mouth of Rock river. The canal will be about 75 miles long, at least 80 feet wide at the water surface, and 7 feet deep. There will be 33 locks, each 170 feet long by 35 feet wide. There will also be a feeder line 29 miles long. Up to the close of the fiscal year 1906, $6,920,941 had been expended on this project. With the completion of this canal in 1907 a 7-foot waterway has been afforded from the Mississippi river to Lake Michigan via the Illinois and Mississippi canal, the Illinois river, and the Chicago Drainage and Ship canal.

Of the many projects now before Congress, that of a

[1] Report of Chief Engineer of The Public Works of Ohio, 1903, page 52.

14-foot waterway connecting Lake Michigan with the Mississippi river via the Illinois river, and thence to St. Louis, a distance of about 365 miles, is one of the greatest. It is proposed to canalize the Illinois river from Lockport to Utica by 9 locks, 600 feet long and 80 feet wide, and 5 new movable dams, and to utilize the open river from Utica to Grafton, at the mouth of the Illinois river, by removing the 4 existing dams and dredging a channel 200 feet wide on the bottom. At Lockport the Illinois river will be connected with the Chicago Drainage and Ship canal. At Joliet and Marseilles there will be lateral canals each 3 miles long.

Michigan.—A history of the St. Marys canal—now a Federal Government undertaking—down to 1880 was contained in the report on canals for the Tenth Census. Since that report, however, the 2 old state locks have been destroyed to make room for the Poe lock, which was completed in 1897. This lock is 800 feet long, 100 feet wide, and has 22 feet of water over the sills. The canal was lengthened from 1.02 miles in 1880 to 1.6 miles in 1906. It has a depth of 25 feet. As a result of the large increase in tonnage transported through this canal the Fifty-ninth Congress authorized the construction of still another lock. The new lock will lie north of the Poe lock, will be 1,350 feet long and 80 feet wide, and will have a minimum depth of 24.5 feet. A new canal approach is also to be constructed, which will be from 260 to 300 feet wide. The estimated cost is $6,200,000, of which $1,200,000 has already been appropriated, with authority from the Secretary of War to enter into contract for an additional sum not to exceed $5,000,000.

Wisconsin.—The Fox and Wisconsin rivers are only 2 miles apart at Portage; one flows into Lake Michigan and the other into the Mississippi. The headwaters are connected by a short canal known as the Portage canal. The Fox river is canalized from Lake Winnebago to Green bay. The Sturgeon Bay and Lake Michigan canal, extending from the bay to the lake, is almost 1¾ miles long. It was originally built by a private company, but was assumed by the Federal Government in 1893. The improvement of these and other waterways in the state continues with little interruption.

Minnesota and North Dakota.—The Red River (of the North) rises in Lake Traverse and, flowing north, empties into Hudson bay. It was a steamer route until railways were built, and has 2 feet of water below Grand Forks, and 18 inches from Moorhead to Fargo. Navigation is confined to short reaches north and south of Grand Forks. The Minnesota river, which empties into the Mississippi at St. Paul, is partly navigable for from 40 to 80 miles above that city. A writer suggests a great artificial waterway from St. Paul up the Minnesota, through the two lakes and down the Red River (of the North), to make the Canadian waterway system a part of ours, and to offer the Canadian wheat growers cheap transportation to the mills and elevators of Minneapolis.[1]

Missouri.—The improvement of the Missouri river from Kansas City and St. Louis to a low-water depth of 12 feet is deemed perfectly practicable. Government engineers estimate the cost of a 14-foot channel to be $20,000,000. If the river were improved with a 12-foot channel to Sioux City, Iowa, the cost as estimated would be $20,000,000 more. This work would open a direct waterway to New York city via the Mississippi, the deepened Illinois, the Chicago Drainage and Ship canal, the Great Lakes, and the Erie barge canal. The Missouri river was first navigated by steamboats in 1819, but commerce has been diverted to other channels. There are signs of revival, however; a line of freight and passenger boats is making regular trips between Kansas City and St. Louis. Over $11,000,000 have been expended on the Missouri river by the Federal Government. It is asserted that no permanent good to navigation can be accomplished by efforts in scattered localities; but no project for the improvement of the river as a whole has yet been adopted.

The White river in its original condition was much choked by logs, snags, and drift in its lower reaches in Arkansas, and by shoals, bowlders, and snags in its upper reaches above Jacksonport. The original project of 1871 was to remove snags and similar obstructions, the improvement being subsequently extended to Forsyth, the object being to obtain a channel 5 feet deep at low water from the mouth at Newport, Ark., and 2 feet deep from Newport to Buffalo shoals. The existing project for the improvement of the upper White river by locks and dams is to provide slackwater navigation from Batesville, Ark., to Buffalo shoals, a distance of 89 miles, by 10 locks and dams, the locks to be 175 feet long by 36 feet wide, with a depth of about 4 feet on the lower miter sills. Two of these locks have been completed and are in operation. The further construction of locks and dams on this river is not considered desirable at the present time. The head of steamboat navigation is Forsyth, 505 miles from the mouth of the White river.

SOUTH CENTRAL DIVISION.

Kentucky.—The Tennessee river is 652 miles long, and is formed by the junction of the French Broad and Holston rivers, 4.5 miles above Knoxville and 188 miles above Chattanooga. It flows into the Ohio river at Paducah, Ky., 464 miles below Chattanooga. Together with its principal tributaries it forms a system of internal waterways navigable by steamboats for more than 1,300 miles. By means of training walls, wing dams, and dredging, a low-water channel 3 feet deep is projected above Chattanooga to the

[1] Herbert Quick, "Inland Waterways," in Putnam's and the Reader, May, 1908, page 194.

mouth of the French Broad river. Between Chattanooga and Riverton, Ala., a lateral canal, 18 miles in length with 11 locks, has been constructed around the Elk river and Big Muscle shoals. A lock is being built at Hales bar, about 33 miles below Chattanooga, and a lateral canal 8 miles in length with 1 lock is under construction at the Colbert and Bee Tree shoals, between Florence and Riverton, Ala. From Riverton to Paducah, Ky., where the Tennessee empties into the Ohio, a 5-foot channel is being dredged.

The Cumberland river rises in eastern Kentucky, flows in a tortuous course of about 688 miles through eastern Kentucky, middle Tennessee, and western Kentucky, and empties into the Ohio river near Smithland, Ky. The project for the canalization of this river contemplates the construction of 35 locks and dams so as to afford 6-foot navigation from the mouth of the Rockcastle river, 32 miles above Burnside, Ky., to Smithland, a distance of 550 miles. Of these locks and dams, 6 are to be at Smith shoals above Burnside; 22 between Burnside and Nashville, Tenn.; and 7 between Nashville and Smithland. Two of the locks below Nashville and one above are completed. The river is now canalized from a point 41.5 miles below Nashville to 26 miles above. The estimated cost of the entire work is about $10,000,000.

The Big Sandy river is formed by the confluence of the Levisa and the Tug forks at Louisa, Ky., 26 miles from where it empties into the Ohio river at Catlettsburg, Ky. The accepted project for the improvement of this river contemplates its canalization to Louisa by means of 3 locks and dams. This project also includes the canalization of Levisa Fork up to Pikeville, Ky., 86.5 miles above Louisa, by means of 10 locks and dams, and Tug Fork up to Pond creek, Ky., 27 miles above Louisa, by means of 8 locks and dams. The 3 locks and dams on the Big Sandy river below Louisa are now in operation, and the first lock on each of the two forks is under construction. The estimated cost of this project is about $5,000,000.

The Kentucky river empties into the Ohio river at Carrollton, Ky., about midway between Cincinnati and Louisville. From 1835 to 1839 the state of Kentucky improved the stream by constructing 5 locks and dams, which afforded slack-water navigation for about 95 miles from its mouth. In 1880 jurisdiction over this river was ceded to the Federal Government, and the accepted project for its improvement was to extend 6-foot slack water from its mouth to the Three Forks, a distance of about 261 miles, by the rebuilding of the old state locks and the construction of 9 additional locks. Of this work, the old locks have been rebuilt and 6 new locks constructed and put in operation. Navigation now extends to Irvine, Ky., about 226 miles from the mouth.

The Green river empties into the Ohio river about midway between Evansville and Newburg, Ind. The Barren river empties into the Green river about 145 miles above the mouth of the latter stream. The state of Kentucky improved these streams, during the period from 1833 to 1841, by constructing 4 locks and dams on the Green river and 1 lock and dam on the Barren river, which work permitted continuous navigation from the mouth of the Green river to Bowling Green, Ky., on the Barren river, a distance of about 175 miles. In 1888 the Federal Government assumed control, and in accordance with the accepted project rebuilt the 5 old state locks and constructed 2 new locks on the Green river. The completion of this work permits through navigation for boats not exceeding 5 feet draft from the mouth of the Green river to Mammoth Cave, Ky., a distance of about 193 miles, and to Bowling Green, Ky., on the Barren river, a distance of about 175 miles from where the Green river empties into the Ohio river, and affords transportation facilities to the rich mineral district bordering on these streams. Slack-water navigation can be extended to the mouth of Little Barren river, about 50 miles above Mammoth Cave, by the construction of 6 more locks and dams, and to Ray's Fork on the Barren river, about 24 miles above Bowling Green, by means of 2 additional locks and dams.

The Rough river empties into the Green river at Livermore, Ky., about 70 miles above the mouth of that river. Shortly after the Civil War the Rough Creek Navigation and Manufacturing Company built a lock and dam about 7 miles above Livermore which afforded slack-water navigation throughout the year to Hartford, Ky., about 29.5 miles above the mouth of Rough river. When the Federal Government undertook, in 1894, the construction of a lock on this stream, the old lock and dam had been abandoned and were completely in ruins. While the accepted project for the improvement of this river contemplated only the extension of slack-water navigation to Hartford by the construction of one lock and dam, which were completed and in operation in December, 1896, the improvement could be extended to Green's Dam, 81 miles from the mouth, by the construction of 4 additional locks and dams.

Alabama.—The Black Warrior, Warrior, and Tombigbee rivers, together with the Mobile river, connect the Warrior coal fields with the Gulf of Mexico. The Black Warrior is formed by the junction of the Mulberry and Locust forks, 46.5 miles above Tuscaloosa, where the name changes to Warrior river. The Warrior river flows into the Tombigbee river about 1 mile above Demopolis, which is 185 miles above the mouth of the Tombigbee river. The total length of these rivers from Mulberry and Locust forks to the mouth of the Tombigbee river is about 365 miles. Previous to improvement the Tombigbee river was navigable for light-draft vessels to Demopolis for about nine months annually, and the Warrior to Tuscaloosa for about four months annually. Tuscaloosa was considered the head of navigation. Rafts and flatboats were

brought down the Black Warrior river on floods, but there was no other navigation on this stream. The improvement of the Tombigbee began in 1872, under a project for the removal of snags, logs, and other obstructions, with a view to obtaining a channel of an available depth of from 3 to 4 feet. Work was carried on under this and modified projects for a number of years. During the progress of the work it became apparent that this method of improvement was inadequate, as a greater depth was demanded for the transportation of coal from the Warrior fields to the sea. In 1884 a 6-foot slack-water project was inaugurated for the Black Warrior river in the vicinity of Tuscaloosa. This project has been gradually extended, and now embraces the Tombigbee river from its mouth to Demopolis, the Warrior river from Demopolis to Tuscaloosa, and the Black Warrior from Tuscaloosa to Mulberry and Locust forks. Upon the Tombigbee river the 3 required locks have been partially constructed, and of the 6 locks planned for the Warrior river, 3 have been completed and the balance are under construction. Of the 11 locks required upon the Black Warrior river, 4 have been completed and 2 more are under construction. The Fifty-ninth Congress appropriated $350,000 toward the completion of the improvements on these rivers and gave the Secretary of War authority to enter into contracts for a sum not to exceed $1,842,000, to be hereafter appropriated.

At the Muscle Shoals canal a railroad nearly 15 miles in length is operated in connection with its maintenance. A bucket dredge is kept on the canal to remove bars as fast as they are formed by the inrush of 15 streams.

Mississippi.—The rivers, harbors, and passes of the state have been improved regularly, but there are no canals or canalized rivers.

Louisiana and Arkansas.—The mouths of the Mississippi furnish a notable system of internal waterways. The principal stream has a depth suitable for ocean shipping for hundreds of miles, or to the mouth of the Red river. There are also bayous stretching to the westward through plantations where steamers can load with sugar cane, rice, cotton, etc. A number of private ship canals are also a part of this system of inland communication. One of these is the Barataria and Lafourche canal, known as the company's canal. It extends from the Mississippi opposite New Orleans to the Atchafalaya river at Morgan City, running through 5 parishes and crossing or connecting with 23 navigable streams or lakes. Several of the bayous and rivers of the state are under improvement by the Federal Government.

The improvement of the Ouachita river by the United States commenced in 1871. At that time navigation was much obstructed at all stages, and the greater part of the river was navigable at low water. The project of 1871 contemplated temporary improvement from Trinity, La., to Arkadelphia, Ark., by removal of snags, etc., and by dredging the worst bars. In 1872 a project was adopted for locks and dams to give a depth of 4 feet from Trinity to Camden, Ark., but this project was abandoned two years later. The project under which work continued after 1874 contemplated the removal of obstructions below Camden, Ark. The 56 miles known as Black river, below Trinity to Red river, La., were added to the project in 1884. The existing project, besides including a continuation of the snagging work, contemplates the construction of 9 locks and movable dams, to afford a navigable depth of 6.5 feet from the mouth of Black river, La., upstream to a point 10 miles above Camden, Ark., a distance of 360 miles. The rivers and harbors act of June 13, 1902, authorized the building of a lock and dam near Monroe, La., 183 miles above the mouth of the river, and a lock and dam near Roland Raft, Ark., 238.5 miles above the mouth. At moderately high stages, or for 6 or 7 months of the year, New Orleans steamboats ascend the river to Camden, Ark.; at medium stages they run to Monroe, La.; but during the periods of low water Harrisonburg, La., is considered the head of navigation. The commerce of Ouachita river and its tributaries is considerable and consists of shipments of cotton, cottonseed, lumber, staves, saw logs, and miscellaneous articles, with return freights of general merchandise and plantation supplies. Most of the cotton is shipped to New Orleans, and large quantities of staves for export are sent to that city.

Texas.—The 25-foot ship canal from the Gulf to Port Arthur, called the Port Arthur canal, was opened in 1899, and is now in charge of the Federal Government, having been transferred to it by the canal company in 1906. The Galveston and Brazos canal, bought by the United States in 1902 of the navigation company owning it, is 29.5 miles long and has a ruling depth of 3 feet. The Government has already made estimates for a great inland waterway from the Rio Grande to the Mississippi river at Donaldsonville, La. The figures are: Aransas Pass to Pass Cavallo, $65,850; Brazos river to Galveston, $141,528.80; Franklin to Mermentau river, $289,292—a total of $496,670.80. The section Donaldsonville to Franklin is already under improvement. Another work already begun is the construction of an inland waterway along the coast. "The object of the improvement is to obtain and maintain a navigable channel depth of 5 feet in a canal along the coast of Texas, underlying the lagoons lying between the islands and the mainland. The improvement will develop a light-draft inland navigation which will afford cheap transportation by light-draft steamers and barges on the coast country of Texas. More and larger boats with auxiliary gas engines have been built to utilize the improvement. Most of the points to be reached are settlements which railways can not afford to develop, but the improvements are of greater importance to their commercial life." [1] The localities

[1] Report of the Chief of Engineers, U. S. Army, 1907, River and Harbor Improvements, Part I, page 443.

to be improved are West Galveston bay and Brazos River canal; the channel from Aransas Pass to Pass Cavallo, including the Guadalupe river to Victoria; and Turtle Cave channel and Aransas Pass to Corpus Christi. Many of the larger rivers of the state have been improved, one of the principal projects under way being the deepening and canalization of the Trinity to Dallas, 511 miles from its mouth, thus affording a navigable waterway which will almost reach the northern border of the state.

The Morris and Cummings canal is under private ownership. It extends from Corpus Christi bay to Aransas bay, a distance of 9 miles, and has a depth of from 6.5 to 10 feet.

WESTERN DIVISION.

Washington.—Eighty miles of the Columbia river are under improvement, between Wenatchee and Bridgeport, and there are plans for further improving parts of the Okanogan and the Pend d'Oreille rivers. The county of King in 1906 voted a bond issue of $500,000 to induce the United States to join in the work of constructing a canal, with a depth of 25 feet at low water, connecting Puget Sound with Lake Washington. March 13, 1907, the legislature created a local assessment district and empowered it to raise money by taxation to aid in the construction, the money to be expended under the direction of the United States engineer officer. In addition to the payments for the right of way, these sums will provide $1,500,000 toward the expense of construction.

Oregon.—The Columbia river forms the boundary between Oregon and Washington in the lower 330 miles of its course. For ships crossing the bar at the mouth of the Columbia river the head of deep-sea navigation is Portland, Oreg., 12 miles up the Willamette river, which empties into the Columbia river 98 miles from its mouth. Vancouver, Wash., is located on the Columbia river about 5 miles above the mouth of the Willamette river, and channel dredging has furnished low-water navigation to that city for ships drawing 20 feet of water. At the Cascades, 160 miles from its mouth, where the Columbia river passes through the Cascade mountains, it is contracted into the narrow width of a gorge with steep slope and swift current. The improvement at this place by the Federal Government resulted in the construction of 2 locks, with a low-water depth of 8 feet over the miter sills, which were opened to navigation in 1896 and enabled vessels drawing not more than 8 feet of water to proceed up the river to The Dalles, about 210 miles from the mouth. From the foot of The Dalles rapids to Celilo falls, 12 miles upstream, navigation is completely obstructed by reason of the gorged condition of the channel, obstructing rocks, and powerful currents and eddies. The accepted project for the improvement of this stretch of the river provides for the construction of a canal about 8.5 miles long, 65 feet wide on bottom, and 8 feet deep, with locks 300 feet long and 45 feet wide, at an estimated cost of about $4,000,000. Construction work for this undertaking has been commenced, and when the work is completed through navigation will be possible for light-draft boats to beyond Lewiston, Idaho, 149 miles above the mouth of the Snake river, a tributary of the Columbia river. A portage railroad was built and is now operated by the state around the falls and rapids, between The Dalles and Celilo.

The Willamette River canal at Oregon City belongs to the Portland General Electric Company, is about 3,500 feet long, and connects the upper and lower river, heretofore made impassable by falls.

California.—From 1875 to June 30, 1907, the Federal Government expended $878,749 in improving the Sacramento and Feather rivers. The former is navigable from Sacramento to Red Bluff, 262 miles. The Feather river is navigable for gasoline boats and launches from its junction with the Sacramento to Marysville. The San Joaquin river is also being improved. At high water boats go occasionally to Firebaugh, 300 river miles above Stockton. A canal is to be cut to divert the waters of the Mormon channel into the Calaveras river, but the city of Stockton must furnish the right of way. The canalization of the Sacramento and the San Joaquin is suggested as part of a plan to furnish an inland waterway from the upper to the lower part of the state.